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PHYSICS ABSTRACTS

SECTION A

of

SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

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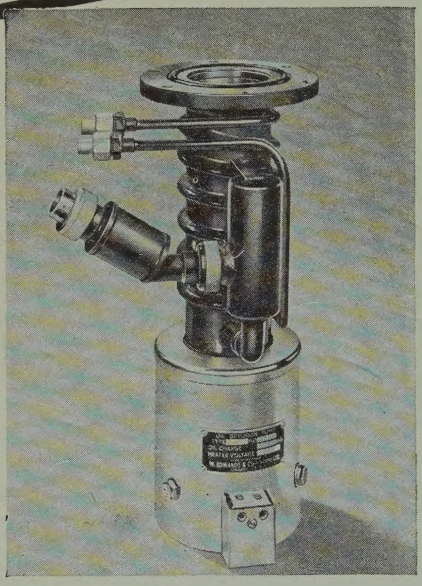
ABSTRACTS 5267–5826

VOLUME 56 **AUGUST 1953** NUMBER 668

Invaluable for VALVELESS Vacuum Systems . . .

NEW FLUID ECONOMISER for vapour pumps



Valveless vacuum systems afford maximum simplicity for rapid exhausting systems, such as C.R.T. units, but frequent rough pumping through the hot vapour pump causes its operating fluid to be carried over as mist into the backing system, resulting in waste and lost working hours.

EDWARDS have solved this problem by introducing an ingeniously simple and highly effective FLUID ECONOMISER—a device designed to recover and return the greater part of the exhaust mist back to the vapour pump.

This compact device is equally valuable to combat mist loss following from large leakage or breakage.

EDWARDS MINIATURE OIL DIFFUSION PUMPS

MODEL	VACUUM mm Hg	BORE SIZE ins.	SPEED		STAGES
			Unbaffled	Baffled	
102	5×10^{-6}	1	9–10	7–8	2
203	5×10^{-6}	$2\frac{1}{4}$	70–80	50–55	3

for better vacuum service . . . **W. EDWARDS**

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LOWER SYDENHAM, LONDON, S.E.26.

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RELATED SUBJECTS CONTAINED IN SECTION B (ELECTRICAL ENGINEERING ABSTRACTS)

Electrical and magnetic measurements and instruments
Electronic relays and counters
Automatic control mechanisms
Applied electrochemistry
Photocells
Thermionic tubes
Cathode-ray tubes
X-ray tubes
Amplifiers
Radiocommunication
Mechanical engineering
Illumination

JOURNALS ABSTRACTED COMPLETELY

The following list gives the names of those journals whose contents, being entirely original contributions in Physics or Electrical Engineering, are currently being abstracted completely in one or other section of *Science Abstracts* (transient and non-scientific items excepted). This list supersedes lists published earlier.

Acta Physica Austriaca
Acta Physica Hungarica
Acta Physica Polonica
Acustica
Advances in Physics
Akustische Beihefte
Alta Frequenza
Annalen der Physik
Annales de Physique
Annales de Radioélectricité
Annales de Télécommunication
Archiv der elektrischen Übertragung
Archiv für Elektrotechnik
Arkiv för Fysik
Australian Journal of Physics
Bell System Technical Journal
British Journal of Applied Physics
Cahiers de Physique
Canadian Journal of Physics
Chinese Journal of Physics
Electronics
Elektrichestvo
Frequenz
Helvetica Physica Acta
Indian Journal of Physics
Journal of the Acoustical Society of America
Journal of Applied Physics
Journal of Chemical Physics
Journal of the Optical Society of America
Journal of the Physical Society of Japan
Journal de Physique et le Radium
Journal of Scientific Instruments
Nuovo Cimento
Optik
Philosophical Magazine
Physica
Physical Review
Proceedings of the Institute of Radio Engineers
Proceedings of the Institution of Electrical Engineers
Proceedings of the Physical Society
Progress of Theoretical Physics
Reports of the Physical Society on Progress in Physics
Review of Scientific Instruments
Reviews of Modern Physics
Revue d'Optique
Transactions of the American Institute of Electrical Engineers
Wireless Engineer
Zeitschrift für angewandte Physik
Zeitschrift für Naturforschung (a)
Zeitschrift für Physik
Zhurnal Eksperimentalnoĭ i Teoreticheskoĭ Fiziki

An abstract is only published in *Science Abstracts* when an article or book is believed to be generally available. No abstracts are published of dissertations, reports, or memoranda with limited circulation, unless copies have been deposited with several public libraries; nor of papers presented orally at meetings, unless précis of substantial length are published in the normal way.

Thus the appearance of an abstract in *Science Abstracts* may generally be taken to indicate that the original is available through the normal channels, and application should be made to libraries, booksellers or the publishers, not to *Science Abstracts*. Sufficient information for identification, if not given in the abstract, will be found in the "List of Journals" or the monthly supplements thereto.

If no indication of language is given in the abstract, the article may be assumed to be in English. This does not necessarily hold, however, for abstracts reprinted from elsewhere, as indicated at the foot of the abstract.

MATHEMATICS 51

518.1

5267. A new variation method for approximate computation of eigenvalues of Hermitian operators. H. J. MAEHLY. *Helv. phys. Acta*, **25**, *No.* 5, 547–68 (1952) *In German.*

It is well known that the Ritz method will give upper bounds for the lowest eigenvalues; by help of this new procedure, however, upper and lower bounds can be calculated (even for operators whose spectrum extends from $-\infty$ to $+\infty$), if the positions of the neighbouring eigenvalues can roughly be estimated. As an example, the two lowest eigenvalues λ_1, λ_2, of the differential equation (arising in the deuteron problem) $d^2\phi/dx^2 - x^2\phi + \lambda e^{-x}\phi/x = 0$ are calculated with high accuracy. A.

519.2

5268. Trend analysis of physical data. G. E. HUDSON. *Amer. J. Phys.*, **21**, 362–7 (*May*, 1953).

The problem of reduction of data, i.e. the derivation of the value of certain physically meaningful parameters which enter into the analytic description of the trend of the data, is solved by a generalization of the usual methods of fitting empirical curves. In taking a rather general point of view toward this method of trend analysis, the problem of "closeness of fit" is formulated in a new way and investigated briefly. Some applications of the method presented herein are to the problems of the analysis of radioactive samples, of the responses of electrical networks or electromechanical systems, of instrument records and vibrations including drift of the baseline of recording instruments, of variable illumination from stars, and of statistical distributions, and to the problem of differentiation of empirical data. A.

ASTRONOMY . ASTROPHYSICS . GEODESY 52

522.21

5269. The micrometeorological conditions of telescopic observation; an attempt to ameliorate them. A. COUDER. *C.R. Acad. Sci.* [*Paris*] **236**, 780–2 (*Feb.* 23, 1953) *In French.*

A note describing the difficulties found in telescopic observation due to small temperature changes and local air disturbances near the telescope tube and the dome opening. From experiments with the 76 in. reflector at Haute-Provence, it is proposed to destroy natural convection currents by substituting forced draught and to further improve conditions by a system of tube and dome ventilation. E. G. MARTIN

523.11

5270. The origin of the stars. V. G. FESENKOV AND D. A. ROZHKOVSKIĬ. *Dokl. Akad. Nauk SSSR*, **84**, *No.* 5, 917–18 (1952) *In Russian.*

As a result of taking ~150 photographs from the Alma-Ata observatory a new phenomenon was observed in the nebula NGC 6960 in the Swan Constellation. In addition to the individual filaments which in all probability consist of gaseous hydrogen, other filaments were observed which consist not of gas but of a multitude of closely arranged stars which remain clearly visible even in the general spectrum. The linear distance between neighbouring stars in these filaments is roughly 0·14 parsec. A photograph is included. W. HUGHES

523.112 : 530.12

5271. On the displacement of galactic spectral lines and the Hubble–Humason law. Comparison with Lemaître's theory. J. BECQUEREL AND P. COUDERC. *C.R. Acad. Sci.* [*Paris*] **236**, 983–6 (*March* 9, 1953) *In French.*

Corrections to luminosity distances arising from recession effects and space curvature become increasingly important for distant galaxies. These corrections are discussed with special reference to Lemaître's cosmological model. R. A. NEWING

523.112 : 530.12

5272. On some consequences of the expansion of the universe in the exploration of space. J. BECQUEREL AND P. COUDERC. *C.R. Acad. Sci.* [*Paris*] **236**, 1313–16 (*March* 30, 1953) *In French.*

Recession velocities are not necessarily $<c$, as such velocities arise from an expanding metric and are to be distinguished from physical velocities resulting in Doppler shifts. The existence of high recession velocities imposes restrictions on the region of space available to observation, and the nature of these restrictions is here critically examined for a uniformly expanding closed universe. Detailed application is made of the distance-velocity formulae derived for the Lemaître universe (preceding abstract).

R. A. NEWING

523.165

5273. Cosmic electrons as the source of galactic radio noise. G. G. GETMANTSEV. *Dokl. Akad. Nauk SSSR*, **83**, *No.* 4, 557–60 (1952) *In Russian.*

An analysis of the proposition that cosmic noise in the metre wave band is due to electrons with relativistic energies yields a theoretical answer not in disagreement with experimental data. J. M. HOUGH

523.5

5274. The hourly rate of the Quadrantid meteor shower at maximum. J. P. M. PRENTICE. *J. Brit. Astron. Assoc.*, **63**, 175–85 (*April*, 1953).

523.5

5275. The Quadrantid meteor shower radiants from duplicate observations. G. E. D. ALCOCK AND J. P. M. PRENTICE. *J. Brit. Astron. Assoc.*, **63**, 186–8 (*April*, 1953).

523.59

5276. The structure of zodiacal light. A. BEHR AND H. SIEDENTOPF. *Experientia*, **9**, *No.* 4, 134–5 (1953) *In German.*

Photoelectric observations of intensity and polarization in the zodiacal light at Jungfraujoch were reduced under the assumption that the polarization arises from free electrons. This gives a mean electron density of about 600 cm^{-3} near the earth and a density of dust particles of 10^{-15} cm^{-3}, which is nearly constant through the ecliptic. A.

523.72

5277. Centre-to-limb darkening of the sun between 6000 Å and 23 000 Å. R. PEYTURAUX. *C.R. Acad. Sci.* [*Paris*] **236**, 896–7 (*March* 2, 1953) *In French.*

An extension of previous work [Abstr. 7463 (1951)]. New measures are given at 14 different wavelengths, chosen so as to avoid atmospheric absorption bands. The reality of a depression in the absorption curves in region, 10 000–15 000 Å, is confirmed, and attributed to H^-. D. R. BARBER

523.743

5278. Investigations of the photospheric granulation. C. MACRIS. *Ann. Astrophys.*, **16**, *No.* 1, 19–40 (1953) *In French.*

Studying photographs obtained by B. Lyot on the Pic du Midi in 1943 (exposure-time 1/200 sec, intervals about 10 sec), it is found that the size of the granules in green-yellow light (5800 Å) is on the average $1''{\cdot}5$, which is in agreement with Keenan [*Astrophys. J.*, **88**, 360 (1936); **89**, 604 (1939)] but in discordance with several other investigations. The distribution of the granules in size is a Gaussian one. An elongation of the granules in the east–west direction appears to be indicated, but requires further substantiation. Granules near spots are smaller than others, perhaps due to the difference in temperature and magnetic field in these regions. The life-time of the granules in the faculae is similar to that of the photospheric granules, namely 2–9 min; this result is compared with previously obtained data. A. BEER

523.755 : 523.72

5279. Origin of the solar corona. J. H. PIDDINGTON AND R. D. DAVIES. Letter in *Nature* [*London*] **171**, 692–3 (*April* 18, 1953).

Several years' measurements of solar radio noise at frequencies between 600 and 9400 Mc/s are statistically analysed. The total radiation is separated into two components, one associated with the appearance of sunspots, and the other being the residual or basic component. It is found that the sunspot component diminishes less rapidly than the dying spots. The intensities lead to corresponding volumes of gas at suitable temperatures and pressures; e.g. for 600 Mc/s the basic component amounts to $2{\cdot}8\times10^5$ °K. Some very hot high-pressure gas appears near the sunspots, and remains after the spots have vanished, spreading and merging with the surrounding cooler gases. It is concluded that during the period 1947–51 these gases comprised most of the corona and were formed at a rate capable of completely replacing the average corona (Allen, Van de Hulst) in a few days. They are suggested as the principal source of the corona, and it is estimated that if su spots were entirely absent for some months and r other additional source of energy became availabl the corona would diminish to one-tenth the exten or one-third the electron-density, observed durin relatively quiet periods in 1948. A. BEE

523.7

5280. The intensity of the line 6374 Å and the tem perature of the solar corona. A. DOLLFUS. *C.R. Aca Sci.* [*Paris*] **236**, 996–8 (*March* 9, 1953) *In French.*

The profile of the spectral line λ6374 Å has bee measured at more than one hundred points of th solar corona. The dispersion was 3·2 Å/mm, and th accuracy a few per cent. The equivalent width o 0·93 Å was found to be independent of the sun' activity and the height above the horizon, but varie somewhat with the intensity of the emission. Wit decreasing temperature the emission was found t increase at about $2{\cdot}4\times10^6$ degrees; it became very intense at $2{\cdot}0\times10^6$, and decreased again for lowe temperatures below $1{\cdot}7\times10^6$ degrees. A. BEER

523.85

5281. Gravitational condensation of stellar gas and the formation of star clusters. A. I. LEBEDINSKIĬ. *Dokl. Akad. Nauk SSSR*, **84**, *No.* 1, 33–6 (1952) *In Russian.*

Entropy considerations indicate that a homogeneous layer of stellar gas is unstable and that, in the most probable final state, half the stars condensed out of the layer will be united into clusters. This is considered to support the theory of a common origin (from stellar gas) of the stars in clusters in the galactic system, as opposed to the theory of formation of these clusters by association of previously independent stars. R. C. MURRAY

523.852.33

5282. Distances of the Magellanic Clouds. A. D. THACKERAY AND A. J. WESSELINK. Letter in *Nature* [*London*] **171**, 693 (*April* 18, 1953).

A search for RR Lyrae variables in the Magellanic Clouds with the 74 in. reflector of the Radcliffe Observatory in Pretoria succeeded in finding 26 of them in the three clusters NGC 121, 1466 and 1978. Their mean photographic magnitude is $18^m{\cdot}7$, leading to distances of at least 42 kiloparsecs, with an uncertainty of the order of about 25%. These newly derived distances are about double the previously accepted values. They will require an essential change, particularly for periods of about one day, in the shape of the fundamental period-luminosity curve for the Cepheids. A. BEER

523.875

5283. The existence of a maximum in the luminosity function. E. SCHATZMAN. *Ann. Astrophys.*, **16**, *No.* 1, 60 (1953) *In French.*

Based on the recognized laws of mass distribution, and on the mass-luminosity relation, it is shown that the luminosity function must possess a unique max. value which corresponds to a certain stellar mass: since, for small masses, a significant variation of the bolometric correction will result from a small change of mass. D. R. BARBER

523.877

284. The condition of continuity of flux. C. PECKER. *C.R. Acad. Sci.* [*Paris*] **236,** 894–6 (*March* 2, 1953) *In French.*

It is shown that the method adopted to establish conditions for the adiabatic equation of a convection-adiative zone [see Abstr. 5052–3, 6006 (1951)] is capable of generalization, since it is independent of the equilibrium state of the convective zone. D. R. BARBER

523.877

285. Study of the gravity-flux diagram. C. PECKER. *C.R. Acad. Sci.* [*Paris*] **236,** 993–5 (*March* 9, 1953) *In French.*

The g-T_e diagram is divided into regions which are interpreted in terms of the author's stellar models in which an atmosphere of H and He is made up of a convective zone in adiabatic equilibrium below an outer radiative zone. R. A. NEWING

525.35 : 525.623/.624

5286. On "polar tides" in the sea and the earth's atmosphere. I. V. MAKSIMOV. *Dokl. Akad. Nauk, SSSR,* **86,** *No.* 4, 673–6 (1952) *In Russian.*

The theory of Darwin that the 14-month secondary variation in tides is due to the nutation of the earth's axis has been used to see whether there is also an atmospheric oscillation of the same period. Unlike previous analyses of sea-level data, the data for 14-year periods has been so treated that it has been possible to show the existence of an atmospheric oscillation of the same period but of different amplitude and phase to that of the sea. Data are given for the different parts of the globe. J. M. HOUGH

PHYSICS 53

FUNDAMENTALS 530.1

530.12

5287. On gravitational waves and on the motion of gases in strong varying gravitational fields. F. I. FRANKL'. *Dokl. Akad. Nauk SSSR,* **84,** *No.* 1, 51–4 (1952) *In Russian.*

Einstein's gravitational equations are used to solve the problem of determining the gravitational field and the momentum of gases at given initial conditions on a space-like hypersurface. MATHEMATICAL REVIEWS

530.145

5288. On variational methods in collision and diffraction theory. T. KAHAN. *C.R. Acad. Sci.* [*Paris*] **236,** 1000–3 (*March* 9, 1953) *In French.*

The applications of a variational procedure indicated by Courant (1931) are investigated. In particular the relation of this procedure to Schwinger's method [e.g. Abstr. 7020 (1950)] is brought out. L. PINCHERLE

530.145

5289. On the geometric representation of corpuscles and the triple-wave method. F. AESCHLIMANN. *J. Phys. Radium,* **13,** 600–4 (*Dec.*, 1952) *In French.*

Discusses a representation of a particle by a certain space-time function u, which is contrasted with the ψ of wave mechanics. Predictions for a particle described by u are expressed by a functional $X(u, t)$. R. H. DALITZ

530.145

5290. Predictions and the triple wave method. P. DESTOUCHES-FÉVRIER. *J. Phys. Radium,* **13,** 605–8 (*Dec.*, 1952) *In French.*

The calculus of predictions in triple wave theory is compared with that of wave mechanics. The equation of evolution is given for a system of particles and the indistinguishability of particles of the same kind is discussed. R. H. DALITZ

530.145

5291. Solutions of fundamental problems in field theory. I. S. ARZHANYKH. *Dokl. Akad. Nauk SSSR,* **82,** *No.* 4, 545–8 (1952) *In Russian.*

Mathematical. The fundamental problems consist in finding the vector $v(p)$ in the region QS (Q inside or outside S), satisfying $\mathrm{rot}\, v = \vec{\omega}$, $\mathrm{div}\, v = \theta$, where (i) $(v, e_1) = g_1$, $(v, e_2) = g_2$ (e_1, e_2 unit vectors in the surface), (ii) $(v, n) = f$ (n normal vector). This vector is obtainable in closed form provided the solutions $C(t, s)$ and $D(t, s)$ of related integral equations are known. J. JACOBS

530.145

5292. On the propagation of signals in nonlinear field theory. D. BLOKHINTSEV. *Dokl. Akad. Nauk SSSR,* **82,** *No.* 4, 553–6 (1952) *In Russian.*

A rejection of the customary point charges as well as of the linearity of the field equations is considered. This introduces a propagation of interaction (signals) with velocities greater than c. Such anomalous propagation may be characteristic of field theory for small space-time intervals. J. JACOBS

530.145

5293. On the mass of the photon. F. CAP. Letter in *J. Phys. Radium,* **14,** 213–14 (*March*, 1953) *In French.*

In Schrödinger's unitary field theory, a weak e.m. field is shown to satisfy approximately equations which imply a non-vanishing photon mass. R. H. DALITZ

530.145

5294. On eigen-energy of the electron and radiation corrections. YU. V. NOVOZHILOV. *Dokl. Akad. Nauk SSSR,* **83,** *No.* 2, 207–10 (1952) *In Russian.*

The method of Fok functionals is used, in which a wave function of an electron with eigen-energy is defined; it avoids repeated quantization of the electron-positron field. A generating function is obtained from which electromagnetic mass and radiation corrections can be found to any order of e^2. For the case $q = 1$, the approximation for ψ is given to e^4: the e^2 term leads to the Klein–Nishina formula, the e^4 term coincides with radiation correction due to Schafroth [Abstr. 4969 (1949)]. J. JACOBS

530.145

5295. Remarks on the numerical values of the Fermi function. T. YUASA AND J. LABERRIGUE-FROLOW. *J. Phys. Radium,* **14,** 95–9 (*Feb.*, 1953) *In French.*

Graphs are given of the function, calculated from

series developments of the Γ function. From a comparison with other work, it is suggested that the results are valid in the ranges $1{\cdot}002 \leqslant W \leqslant 15\ m_0c^2$; $5 \leqslant Z \leqslant 90$. J. HUGHES

530.145

5296. On the wave-mechanical potentials of the photon and the interactions between electrified particles. S. SLANSKY. *C.R. Acad. Sci.* [*Paris*] **236,** 782–4 (*Feb.* 23, 1953) *In French.*

By a modification of the operators expressing the interaction of a photon with a matter field, equivalent to introduction of a pseudoscalar "photon," the contact potential arising from exchange of a longitudinal photon is eliminated. R. H. DALITZ

530.145

5297. On the question of the transformation properties of wave functions of spin ½ particles. I. S. SHAPIRO. *Zh. eksper. teor. Fiz.*, **23,** *No.* 4 (10) 412–16 (1952) *In Russian.*

The interpretation of time reflections is studied from the point of view that they are formal changes of co-ordinates implying no physical effects. Certain generalizations, leading to the use of 6 dimensions, follow from the existence of different types of non-equivalent spinors. W. J. SWIATECKI

530.145

5298. The relativistic equation of interacting particles. A. D. GALANIN. *Zh. eksper. teor. Fiz.*, **23,** *No.* 5 (11) 488–92 (1952) *In Russian.*

Application of perturbation theory to operator equations in Heisenberg representation leads to solutions more quickly than other techniques, even in problems in which bound states occur. Earlier work is extended here [see Abstr. 7959–60 (1952)]. J. JACOBS

530.145

5299. Remarks on Feynman's method for charged mesons of spin one. M. JEAN AND J. PRENTKI. Letter in *J. Phys. Radium*, **13,** 669 (*Dec.*, 1952) *In French.*

Feynman's rules for the association of operators and propagation factors with meson vertices are modified so as to give equivalent results more simply. W. J. SWIATECKI

530.145

5300. Divisible processes and nonlinearity in the theory of elementary particles. D. IVANENKO AND A. BRODSKIĬ. *Dokl. Akad. Nauk SSSR*, **84,** *No.* 4, 683–6 (1952) *In Russian.*

The creation of several mesons during a single collision of 2 nucleons represents a new fundamental first-order process. It is based on the nonlinear interaction energy of the nucleons with the meson field. Formal nonlinear generalizations, of the field equations and of Dirac's equations for the electron are based on invariances. Phenomenological equations, with the aid of generalized dielectric constants, admit of a more direct physical interpretation. J. JACOBS

530.145

5301. The interaction of nucleons of some hundreds of MeV with nucleons and nuclei. J. HEIDMANN. *J. Phys. Radium*, **14,** 111–20 (*Feb.*, 1953) *In French.*

Summary of scattering theory and review of recent experiments, based on a series of lectures. Angular distributions, exchange forces, repulsive core, nuclear transparency, diffraction. Meson production neglected. Representative references. W. J. SWIATECKI

530.14

5302. Orbital effect in neutron-electron magnetic scattering. W. H. KLEINER. Letter in *Phys. Rev.*, **90,** 1684 (*April* 1, 1953).

Starting with the Hamiltonian of the magnetic spin-spin and spin-orbit *n–e* interaction the differential cross-section is written down in Born approximation in terms of matrix elements of the electronic wave functions of the scatterer. The angular integrals can be evaluated quite generally. W. J. SWIATECKI

530.143

5303. Spin-orbit coupling according to pseudoscalar theory. G. EDER. *Acta phys. Austriaca*, **7,** *No.* 1, 91–5 (1953) *In German.*

The effective potential for a nucleon moving in the field of the nuclear core, assuming psc. mesons with pv. coupling, is shown to contain a spin-orbit coupling term which is in qualitative agreement with experiment, although it is too small in the approximation considered here. R. H. DALITZ

530.145

5304. On the definition of relativistic particle–antiparticle wave-functions. K. BAUMANN. *Acta phys. Austriaca*, **7,** *No.* 1, 98–101 (1953) *In German.*

For bound states of a fermion–antifermion pair, an intuitive graphical argument of the Bethe–Salpeter type [Abstr. 1469 (1952)] is set up, which leads to the use of the two-particle relativistic wave-function of Karplus and Klein, instead of those of Schwinger and of Bethe–Salpeter. R. H. DALITZ

530.162

5305. Einstein's paradox in quantum mechanics. A. D. ALEKSANDROV. *Dokl. Akad. Nauk SSSR*, **84,** *No.* 2, 253–6 (1952) *In Russian.*

The apparent contradiction of the indeterminacy principle propounded in 1935 by Einstein, that it is possible in a system of 2 particles A_1 and A_2, having definite total momentum $(p_1 + p_2)$ and difference of position co-ordinates $(x_1 - x_2)$, to determine exactly p_2 and x_2, without acting on A_2, by making measurements on A_1, is shown to be groundless, since the quantum theory ascribes only a single ψ function to the assembly of 2 particles, which cannot be split into the product of 2 separate functions for each particle, so that there is a definite connection (not a bond in the usual physical sense) between them. The various solutions proposed for the paradox (Bohr's "principle of supplementation" and Blokhinteev's "ensemble" theory) are shown to contain inconsistencies and to have the common error of assuming the separability of the system of 2 particles, i.e. that there is no connection between them. R. C. MURRAY

530.162

5306. A kinetic treatment of saturation and condensation statistics. H. EYRING AND M. WALLENSTEIN. *Proc. Nat. Acad. Sci. U.S.A.*, **39,** 138–45 (*March*, 1953).

A general equilibrium equation is deduced for the adsorption of units at a number of sites. Two main cases arise (*a*) when an absorbed unit saturates the site, and (*b*) when an unlimited number of units may be absorbed at the site. By absolute reaction rate

heory the equilibrium equation may be written in rms of the partition functions for the free units, the ee sites, and for the combined units and sites. Jnder the assumption that the free units have the roperties of an ideal gas, the equations of Fermi–Dirac and Bose–Einstein statistics can be deduced or cases (*a*) and (*b*) respectively. As an extension it s possible to deduce the familiar results for the Helmoltz free energy, for Langmuir's adsorption isoherm, and Richardson's equation for the current eaving a metal surface. H. H. GREENWOOD

530.162

5307. On the theory of excitation spectra of macroscopic systems. YU. L. KLIMONTOVICH AND V. P. SILIN. *Dokl. Akad. Nauk SSSR*, **82**, *No.* 3, 361–4 (1952) *In Russian.*

A complete analogue with classical statistical mechanics can be achieved by a suitable representation of the density matrix, giving a "quantum distribution function" $f(p, q\ t)$. Its time derivative can also be obtained classically, if a finite phase-space is considered. A quantum-kinetic equation can be derived which allows for collisions of particles. The equations determining the spectrum admit Bose–Einstein or Fermi–Dirac systems. Similar methods can be applied to transverse waves in plasma. J. JACOBS

530.162 : 536.7

5308. Do Heisenberg's uncertainty relations prevent Maxwell's demon from operating? N. L. BALAZS. *C.R. Acad. Sci.* [*Paris*] **236**, 998–1000 (*March* 9, 1953) *In French.*

It is shown that the condition that there should be no wave-mechanical restrictions upon the action of Maxwell's demon is equivalent to the condition that the system of particles acted upon by the demon should be non-degenerate (in the sense of quantum statistical mechanics). E. H. SONDHEIMER

530.162 : 539.13

5309. On the spectra of systems of interacting particles. YU. L. KLIMONTOVICH AND V. P. SILIN. *Zh. eksper. teor. Fiz.*, **23**, *No.* 2 (8), 151–60 (1952) *In Russian.*

Vibration spectra of weakly excited states of macroscopic systems were investigated. A quantum-kinetic equation was derived for the distribution function in phase space, which forms a generalization of the well-known classical result. For central force systems the dispersion equation here derived gave the vibration spectra of degenerate Bose and Fermi systems. J. JACOBS

MECHANICAL MEASUREMENTS 531.7

531.717 : 539.165

5310. Measurement of thicknesses under 1 mm with beta rays. A. TROST. *Stahl u. Eisen*, **72**, 941–3 (*July*, 1952) *In German.*

The first part contains a general survey on the application of β-, γ- and X-rays for thickness measurements of metal plates and the accuracy obtained. The second part deals in detail with the possibilities of β-rays for this purpose. According to thickness and material of the plates, radium or artificial radioactive elements are recommended. By suitable choice, the measuring accuracy becomes 1% with a time constant of 0·3 sec for plates or 0·002 up to 1 mm thickness. Data of several radioactive elements and two electric circuits are given. APPLIED MECHANICS REVIEW

531.717 : 539.165

5311. Measurement of the thickness of nonferromagnetic layers on nonferromagnetic support with beta rays and Geiger counter. R. BERTHOLD. *Stahl u. Eisen*, **72**, 945–7 (*July*, 1952) *In German.*

To investigate the thickness of chromium layers (max. 0·1 mm) on aluminum base by means of β-rays of natural and artificial radioactive substances, the X-rays originating in the surface layer are measured by Geiger counters. The energy of the radiation source has to be increased with layer thickness in order to get an equal sensitivity for layers of different thickness. The error in measurement, about 10% in the most favourable case, decreases with increasing difference in the ordinal number of surface and base material. APPLIED MECHANICS REVIEWS

531.717 : 539.166

5312. Measurement of thicknesses from 10 to 100 mm with gamma rays and Geiger counter. W. KOLB. *Stahl u. Eisen*, **72**, 945 (*July*, 1952) *In German.*

Author describes measurements of thickness of 10–100 mm metal plates by means of γ-rays originating in radium, radioactive iridium, cobalt, or selenium, and by use of multiplex Geiger counters. Since the counter works in the proportional range, the errors caused by fluctuations of voltage and temperature are to be eliminated by a differential circuit. APPLIED MECHANICS REVIEWS

531.717 : 539.172.4

An arrangement for measuring the level of heavy water in the Saday reactor. *See Abstr.* 5713

531.768 : 621.317.79

5313. Electronic acceleration indicators. L. A. GONCHARSKIĬ. *Elektrichestvo*, **1952**, *No.* 12, 54–7 *In Russian.*

The design principles of electronic acceleration indicators with moving anode are pointed out with reference to a simple theory of these instruments. Points discussed in more detail are the relation between voltage and sensitivity; advantages of the use of a collector for the anode current in a diode unit; determination of the sensitivity of a triode indicator with moving anode. Formulae are given for determining the current and voltage sensitivity of an indicator with directly heated filament displaced in a homogeneous field. B. F. KRAUS (R)

531.787 : 531.717

5314. A comparator for determining levels or pressures. R. SILBER. *C.R. Acad. Sci.* [*Paris*] **236**, 1138–40 (*March* 16, 1953) *In French.*

A comparator for measuring small differences of level or pressure comprises two chambers enclosed within coaxial cylindrical walls and having a common bottom. Two floats, placed in the respective chambers, the inner cylindrical and the outer annular, are suspended by a beam carrying a pointer arranged to move over a scale arranged to indicate any difference of level in the liquid contained in the chambers, and suitably counterpoised. The apparatus is sensitive to a difference of level of 0·01 mm. J. S. G. THOMAS

MECHANICS OF FLUIDS 532

532.123

5315. Elasticity in liquids. *Nature* [*London*] **171,** 778 (*May* 2, 1953).

A report on a symposium held by the British Society of Rheology in March, 1953. The papers were concerned in the main with (*a*) elastic relaxation and flow in suspensions, (*b*) the relation between shear and bulk viscosity, (*c*) the Weissenberg effect and the delineation of velocity profiles in visco-elastic liquids.

J. E. CAFFYN

532.13 : 535.551 : 541.64

5316. The flow double refraction and viscosity of concentrated solutions of high polymers. B. SCHMIDLI. *Dissert. E.T.H. Zürich, No.* 2101, 84 *pp.* (1952) *In German.*

Describes results of investigations on two polystyrenes in toluene, and three nitrocelluloses in butyl acetate, the polymers being characterized by the extrapolated viscosity values $(\eta_{sp}/c)_{c \to 0}$. In dilute solutions the molecules are probably orientated as a whole, while in concentrated solutions the orientation of chain segments of the long molecules seems to be the main phenomenon. The observation confirms the supposition that polystyrene molecules in solution are more coiled than the nitrocellulose molecules.

F. LACHMAN

532.13 : 541.64

5317. On the mechanism of viscosity of polymer solutions. G. NARSIMHAN. *J. sci. industr. Res.*, **12 B,** 142–6 (*April*, 1953).

An equation of the form $[\eta] = k \,.\, m_p^{\frac{1}{2}}$, analogous to the one proposed by H. Mark (1948), relating the intrinsic viscosity of a linear polymer solution to the molecular weight of the polymer, has been derived. The equation is applicable only to linear polymers of low molecular weight in a state of extreme dilution. A.

532.14 : 531.756

5318. Manometric determination of the density of liquid ozone. C. BROWN AND K. D. FRANSON. *J. chem. Phys.*, **21,** 917–19 (*May*, 1953).

A manometric method for density of liquids at low temperatures is described and applied to liquid ozone. Results in g. cm^{-3}: 1·571 at −183°C, 1·595 at −188°C and 1·614 at −195°C with an average deviation from the mean of ±0·003. A simple method of test for magnetic susceptibility of low-temperature liquid is described and used to detect residual oxygen in liquid ozone. Vacuum-distilled liquid ozone is shown to contain <0·1% oxygen. A.

532.14 : 532.12 : 534.22 : 536.4.031

5319. The ultrasonic velocity, density, and compressibility of supercooled H_2O and D_2O. R. T. LAGEMANN, L. W. GILLEY AND E. G. MCLEROY. *J. chem. Phys.*, **21,** 819–21 (*May*, 1953).

The velocity of compressional waves in liquid water (H_2O and D_2O) has been measured over a range of temperature extending to some six degrees below the nominal freezing point, using a fixed-frequency variable-path sonic interferometer. The density of heavy water in the supercooled state has been determined and values of the adiabatic compressibility calculated. The curves representing the variation of density with temperature are symmetrical and congruent for the two isotopic liquids. It is confirmed that the compressibility of D_2O is greater than that for ordinary water. The new measurements of the three properties yield values which fall on smooth extrapolations of the previously known data, indicating that there is no partial ordering of the liquid structure into the solid structure at temperatures below the nominal freezing point, at least none as times removed from the start of observed freezing. A.

532.5

5320. Some properties of solutions of Navier's equations. A. FORTIER AND J. KRAVTCHENKO. *Cahiers de Phys., No.* 42, 64–75 (*March*, 1953) *In French.*

Navier's equations are very briefly discussed, more especially in terms of a dissipation function, and solutions which should be intelligible to those not too familiar with modern analysis are derived and their physical significance pointed out. In particular, various extensions of the theorems of Bolyleff and of Korteweg, which should interest physicists and engineers, are derived. Thus, e.g., in a steady Poiseuille flow of a viscous, incompressible, gravitating fluid through a cylindrical tube, for a given position of the tube, the distribution of velocities in any normal section is constant. The uniqueness (unicité) theorem stated by the authors leads to the conclusion that the velocity distribution across any normal section of the flow is independent of the inclination of the tube to the horizontal, provided the difference of pressure between the terminal sections is constant; this distribution, for a given inclination of the tube, is independent of the orientation of the section. J. S. G. THOMAS

532.517.4

5321. Algebraic properties of Reynolds' transformations. M.-L. DUBREIL-JACOTIN. *C.R. Acad. Sci.* [*Paris*] **236,** 1136–8 (*March* 16, 1953) *In French.*

Some analytical results relating to the definition and properties of the mean in the theory of turbulence, given by K. de Fériet (1949) are generalized and stated more precisely. J. S. G. THOMAS

532.528 : 539.13

5322. The effect of intermolecular bond strength on the onset of cavitation. J. P. HORTON. *J. Acoust. Soc. Amer.*, **25,** 480–4 (*May*, 1953).

Since bacterial destruction is a cavitation-dependent effect of ultrasound, it has been possible to draw conclusions regarding the factors affecting cavitation by studying bacteriological results. Micro gas bubbles are often described as nuclei for cavitation bubbles. In order to destroy bacteria, however, cavities must form and collapse within several microns of the bacterial cells so that the resulting collapse shock wave will have a high enough energy to rupture the cell wall. Cavitation near the cell occurs most readily when the interfacial linkages between the cell and the surrounding liquid are weakest. When surface-active agents, which strengthen the interfacial linkages, are added to the bacterial suspension, cavitation is inhibited and the ultrasonic death rate decreases markedly. If the bacterial suspension is heated, increasing the energy of the intramolecular bonds, the threshold sound

essure just necessary to kill bacteria is reduced, or, the sound pressure is constant, the bacteria are stroyed at an increasing rate as the temperature creases. Likewise, if alternate cavitation nuclei hich form weaker linkages with the surrounding quid than the initial bacteria are added to the acterial suspension, the killing rate of the original acteria is decreased. A.

CAPILLARITY 532.6

532.61.08

5323. Determination of the surface tension of substances at their melting points. V. I. SMIRNOVA AND B. F. ORMONT. *Dokl. Akad. Nauk SSSR*, **82**, *No.* 5, 751–3 (1952) *In Russian.*

An equation has been developed for a more accurate evaluation of surface tension, based on the form of the solidified drop, and surface tensions have been determined by this method for Sn, Bi, Ag, Au, Cu, Ni and Fe, at their respective melting points. The authors believe, however, that this method cannot yield reliable results in cases when the rate of the drop formation is small. They recommend the method based on the form of the melted drop, provided the drop is photographed or cinematographed during its formation; the surface tension calculated from the successive drop forms tends to a limit which is accepted as the true value of surface tension. The value obtained for Sn is 610 dyn/cm. F. LACHMAN

532.613.4

5324. Interfacial tension between liquid nonmiscible metals. P. V. GEL'D AND S. K. CHUCHMAREV. *Dokl. Akad. Nauk SSSR*, **83**, *No.* 6, 877–80 (1952) *In Russian.*

The interfacial tension σ_i and contact angle θ between fused Pb and Zn was found, by the sessile drop method (the form of a drop of Pb under Zn was photographed in a section after chilling), to be 128 erg/cm², with a contact angle of 40° both with graphite and magnesite supports for the Pb drop. σ_i is considerably less than the difference between the surface tensions of pure Zn and Pb, doubtless because of mutual solution of Pb and Zn. Addition of Na either to the Pb or the Zn substantially lowers σ_i and increases θ. R. C. MURRAY

532.623

5325. The pulsation frequency of nonspherical gas bubbles in liquids. M. STRASBERG. *J. Acoust. Soc. Amer.*, **25**, 536–7 (*May*, 1953).

The effect of non-spherical shape on the pulsation frequency of a gas bubble in a liquid is calculated. The frequency is expressed in terms of a stiffness constant independent of shape and an inertial constant mathematically equivalent to the reciprocal of the electrostatic capacitance of a conductor having the same shape as the bubble. The calculation is carried out for an oblate spheroid, and the variation of the pulsation frequency with shape is shown to be small. The effects of a rigid wall and of a free surface on the pulsation frequency are also calculated by the same method. A.

MOLECULAR THEORY OF LIQUIDS 532.7

532.72

5326. Diffusion with a sharp moving boundary. H. FUJITA. *J. chem. Phys.*, **21**, 700–5 (*April*, 1953).

When the molecules of a diffusing substance react with the medium into which they diffuse in such a manner that they no longer take part in the diffusion process, a sharp boundary line results which is displaced at a rate determined by the conditions of the particular experiment. A theory of this phenomenon was presented by Hermans (1947) and was applied to determine the diffusion constants in some ion-gel systems. In the present paper the method of moments which was recently worked out by Yamada (1950) to deal with the boundary-layer equations is applied to obtain approximate solutions of the basic equations of the Hermans theory for both linear and cylindrical diffusions. The particular concern of the present paper is to analyse the experimental data obtained by Hermans for cylindrical diffusion in a copper ion–cellulose xanthate system on a more reliable basis. It is found that the present analysis provides the diffusion constants which are considerably higher (about 2·6 times) than those evaluated by Hermans. Nevertheless, the values found are still too low as compared with the experimental value determined by the steady-state method, and a further research of the problem needs to be made. A.

MECHANICS OF GASES 533

533.17

5327. Hydrogen jets sensitive to ultrasonic vibrations. The flow of hydrogen jets in air. M. DUBOIS. *C.R. Acad. Sci.* [*Paris*] **236**, 992–3 (*March* 9, 1953) *In French.*

The high kinematic viscosity of hydrogen, resulting from its low viscosity and its very small density, made the gas particularly suitable for the production of high velocity jets which are sensitive to high frequency vibrations. Experiments with jets discharged from cylindrical tubes of diameters less than 1 mm, have established the following conclusions: (1) the existence of a minimum velocity of discharge characterized by sensitivity of the jet to vibrations ranging from the audible to the inaudible, greater than 18 000/sec; (2) the existence of an intermediate velocity such that the jet has a smooth outline for a length of about 6 cm; beyond that length the jet becomes disordered and whistling; under the influence of ultrasonic vibrations the smooth part of the jet disintegrates and the whistling noise is reduced; (3) the existence of a maximum velocity characterized by the existence of smooth jets of length 1·2 cm. A formula for the pressure drop required to produce a mean velocity of discharge, V cm/sec, and taking into account the kinetic energy of the discharge is obtained in the form

$$\Delta P_{\text{cm of water}} = 68\cdot56(LV/1000R^2)\times10^{-5} + 0\cdot09(V/1000)^2$$

The H jets are already sensitive for velocities equal to 2/10 of the critical velocity, but for air jets the velocity

must be at least 3·3/10 and for butane jets 5/10 of the critical velocity. J. S. G. THOMAS

533.275

5328. Measurement of humidity. *Notes appl. Sci. Nat. Phys. Lab., No.* 4, 18 *pp.* (1953).

These notes, intended for the non-specialist, provide a description of the various types of hygrometer available for precise or approximate measurements, with instructions on their use and calibration.

533.64

5329. The gas flow past slender bodies. M. M. MUNK. *J. appl. Phys.*, **24,** 584–9 (*May*, 1953).

Relates to moving objects immersed in a perfect gas otherwise at rest. The momentum of the resulting gas flow is defined. It is shown that it ultimately approaches a definite magnitude as the object assumes a steady motion, this magnitude being independent of the history of the previous motion. This result is applied to the two-dimensional flows of airship theory, and thus the airship theory is extended to include compressibility effects to a limited extent. A.

533.7 : 539.13

Intermolecular force constants from thermal diffusion and other properties of gases. *See Abstr.* 5618

MOLECULAR THEORY OF GASES 533.7

533.75

5330. Apparatus for the rapid experimental study of the equations of state of gases at high temperatures. J. R. SAUREL. Letter in *J. Phys. Radium*, **14,** 215–16 (*March*, 1953) *In French.*

Two simple arrangements for trapping a known volume of gas in a heated Pyrex bulb and determining the change in its volume when it is compressed by applying external pressure to an Hg (or Ga) seal.

R. C. MURRAY

VIBRATIONS . ACOUSTICS 534

534.014.2

5331. Arithmetic determination of the amplitude of forced vibrations by means of the effective mass method. T. O'CALLAGHAN. *Frequenz*, **6,** 327–9 (*Nov.*, 1952) *In German.*

The most frequently used method, due to Holzer, necessitates additional calculations if the moments are phase-displaced; these are avoided in the e.-m. method described. The calculation is based on the superposition principle, and a worked example is given.

C. F. PIZZEY

534.014.2

5332. The graphic determination of effective masses and resonance frequencies in torsional vibrating systems. T. O'CALLAGHAN. *Frequenz*, **6,** 369–74 (*Dec.*, 1952) *In German.*

Existing methods are reviewed, and the amount of (graphic) construction which they entail is considered. Graphic methods are described which require a minimum of construction. The bibliography contains 52 items. C. F. PIZZEY

534.014.

5333. The effect of minor system changes on th resonance frequencies of torsional vibrating systems T. O'CALLAGHAN. *Frequenz*, **7,** 18–20 (*Jan.*, 1953) *In German.*

Expressions are given for determining the effects o small changes of mass, or stiffness, e.g. those due t normal manufacturing variations. C. F. PIZZEY

534.014.2

5334. The correction of approximate derived resonance frequencies by means of the J_{eff}-value. T. O'CALLAGHAN. *Frequenz*, **7,** 41–3 (*Feb.*, 1953) *In German.*

Two correction formulae are given, one based on the relation $dJ_{eff}/d\omega$, the other on $\Sigma J/J_{\epsilon ff}$, with a worked example. C. F. PIZZEY

534.014.2

5335. Algebraic applications of the e.m.-method. T. O'CALLAGHAN. *Frequenz*, **7,** 43–7 (*Feb.*, 1953) *In German.*

A proof is given of the so-called Baranow theorem, and a physical interpretation of the escalator-equation due to Morris. C. F. PIZZEY

534.014.5

5336. Subharmonic oscillations in nonlinear systems. C. HAYASHI. *J. appl. Phys.*, **24,** 521–9 (*May*, 1953).

It is first shown that the order of the subharmonics has a close connection to the form of the non-linear characteristics. The subharmonic of order $\frac{1}{3}$ is then particularly investigated for the cases in which the non-linear characteristics are expressed by (1) cubic and (2) quintic functions. In both cases the stability problem of the periodic solution is discussed in detail according to the stability criterion given previously by the author. In case (2) the second higher-harmonic of the subharmonic, i.e. the oscillation of order $\frac{2}{3}$, builds up with negative damping. This is verified by experiments in which the oscillation of order $\frac{2}{3}$ causes the collapse of the original subharmonic oscillation. A.

534.121

5337. Axially symmetric vibrations of a finite isotropic disk. III. R. R. AGGARWAL. *J. Acoust. Soc. Amer.*, **25,** 533–5 (*May*, 1953).

For Pt II see Abstr. 669 (1953). The different real values of α for the same frequency have been obtained by solving the frequency equation graphically. When three such values of α exist, three independent boundary conditions have been made to satisfy at the curved surface of the disk. The resonant frequencies for which these conditions hold good have been evaluated, and the corresponding displacement curves for the vibrating faces of the disk have been compared with the experimentally obtained curves for the barium titanate discs. A test for the validity of this method has been provided by comparing the residual stresses at the curved surface with the compressional component of the stress at the centre of the disk. A.

534.213 : 550.834

5338. Propagation of acoustic waves in a liquid-filled cylindrical hole, surrounded by an elastic solid. E. V. SOMERS. *J. appl. Phys.*, **24,** 515–21 (*May*, 1953).

The theory of elastic wave propagation in systems where discontinuities in the physical properties occur

long concentric cylindrical surfaces is developed for n impulsive ring-shaped source. This source is mathematically similar to the point source discussed by Lamb and Pekeris. The field problem is solved for liquid-filled column, surrounded by an elastic solid, epresenting a basic model applicable to well-logging roblems. A.

534.22 : 532.12 : 536.4.031 : 532.14

Ultrasonic velocity of supercooled H_2O and D_2O. *See Abstr.* 5319

534.22 : 532.51 : 538.566

5339. Longitudinal magneto-hydrodynamic waves. N. S. ANDERSON. *J. Acoust. Soc. Amer.*, **25**, 529–32 (*May*, 1953).

For a conducting fluid the presence of a strong magnetic field, on the basis of Alfven's theory, will change the sound propagation velocity. This change results from the additional forces on the conducting fluid due to the motion of the fluid in the magnetic field. The theory is extended to a fluid with finite conductivity. The case discussed deals with plane waves whose propagation direction is perpendicular to the direction of the magnetic field. It is found that the finite conductivity introduces dispersion and absorption into the propagation, which has the form of a reversed "relaxation type" frequency dependence, with the velocity decreasing with increasing frequency. The theory is applied to predict the results that would be obtained for two experiments: the propagation of sound in mercury in a very strong magnetic field; and second, the propagation of sound in sea water and the influence of the earth's magnetic field. A.

534.222.2 : 533.7

5340. The calculation of the thickness of shock waves in argon. S. TRAVERS. *C.R. Acad. Sci.* [*Paris*] **236**, 889–91 (*March* 2, 1953) *In French.*

Taking account of the increase of viscosity with temperature, and the accessory increase of transport coefficients in accordance with Chapman's formulae for non-uniform gases, a formula is derived for the thickness, ε, of shock waves in argon at any temperature; theoretical values of ε at 298°K and atmospheric pressure corresponding to Mach numbers, (M), 1.215, 1·377 and 2·085 agree, to within $\pm 15\%$ in the case of the two former and $\pm 25\%$ in the case of the last with values found by Greene *et al.* [Abstr. 4184 (1951)]; values are also calculated for $M = 3$, 5 and 10. Differences are within the possible limits estimated by Greene *et al.* J. S. G. THOMAS

534.23

5341. A review of the influence of meteorological conditions on sound propagation. U. INGÅRD. *J. Acoust. Soc. Amer.*, **25**, 405–11 (*May*, 1953).

The study of the different atmospheric effects indicates that in short-range sound propagation the attenuation by irregularities in the wind structure (gustiness) is often of major importance in comparison with humidity, fog and rain, and ordinary temperature and wind refraction. However, the ground attenuation can be of equal importance to the gustiness, in particular, when the sound source and the receiver are sufficiently close to the ground. The effect on the attenuation of the height of the source and the receiver off the ground is presented as a function of frequency for a typical ground impedance. The attenuation curve exhibits a maximum which in most cases lies at a frequency between 200 and 500 c/s. A.

534.23

5342. Absorption of sound in binary mixtures. I. G. SHAPOSHNIKOV AND Z. A. GOL'DBERG. *Zh. eksper. teor. Fiz.*, **23**, *No.* 4 (10), 425–9 (1952) *In Russian.*

Starting from the fundamental equations of hydrodynamics, an expression is derived for the portion γ of the absorption coeff. of sound of small amplitude in a binary liquid or gaseous mixture, which describes the absorption caused by diffusional effects. For a mixture of ideal gases the result agrees with that obtained by Kohler [*Ann. Phys.* [*Leipzig*] **39**, 209 (1941)] from kinetic theory. The modified form of γ when the concentration of one of the components of the mixture is low is derived. These results may be of value for the experimental determination of the coeff. of thermal diffusion. R. C. MURRAY

534.23 : 541.64

5343. The absorption of ultrasonic waves in benzene solutions of methyl metacrylate in different polymerization stages. Y. WADA AND S. SHIMBO. *J. Acoust. Soc. Amer.*, **25**, 549–52 (*May*, 1953).

Measurements of ultrasonic absorption are performed by a pulse method in benzene solutions of nine sorts of methyl metacrylate specimens of different intermediate polymerization stages, including the monomers and the final product of polymerization. In the case of the monomer, the absorption decreases rapidly with concentration. Solutions of the polymers without unreacted monomers show a similar absorption coefficient to that of benzene itself, in spite of the remarkably high viscosity. For the intermediate products the fraction of polymers is estimated from the absorption coefficient, assuming that only the unreacted monomers have influence on the absorption. For the solutions of the specimens in which the fraction of polymers is fairly large, the above assumption requires some modifications. In this case some parts of unreacted monomer molecules seem to be enclosed in the network structures of polymers and deprived of their influence upon the absorption. A.

534.23 : 541.182.2

5344. The absorption of sound in suspensions and emulsions. I. Water fog in air. P. S. EPSTEIN AND R. R. CARHART. *J. Acoust. Soc. Amer.*, **25**, 553–65 (*May*, 1953).

The suspended particles are approximated by spheres and the diffraction problem for a fluid sphere in a fluid medium is solved taking into consideration viscosity and thermal conduction. The results are discussed numerically for water droplets in air, and a satisfactory agreement with Knudsen's attenuation measurements in water fog is found. A.

534.231.2

5345. Surface and volume sources of vorticity in acoustic fields. H. MEDWIN AND I. RUDNICK. *J. Acoust. Soc. Amer.*, **25**, 538–40 (*May*, 1953).

When a sound beam passes through a viscous fluid, vorticity is generated as a second-order effect and

streaming results. The work of Eckart, which considers the vorticity generated in the medium, is extended to consider "surface sources" of vorticity which appear when the sound beam makes contact with a solid restraining surface. As in the Eckart work, the dynamic shear viscosity coefficient μ is assumed to be independent of the density changes which accompany a sound wave. However, the effect of a density-dependent bulk viscosity coefficient is investigated, and it is found that the sources of vorticity are unaffected. Previous work on streaming by other authors is discussed and reconciled, and it is shown that in many cases the predominant sources of vorticity are the "surface sources." A.

534.25

5346. The dispersion of a pulse propagated through a cylindrical tube. D. V. Anderson and C. Barnes. *J. Acoust. Soc. Amer.*, **25**, 525–8 (*May*, 1953).

The dispersion of an ultrasonic pulse propagated through a circular tube filled with water has been observed to agree sufficiently closely with the theory that the envelope of the dispersed pulse may be used for the approximate determination of the frequency spectrum of the original pulse. A.

534.26

5347. Diffraction patterns for solid delay lines. R. A. Mapleton. *J. Acoust. Soc. Amer.*, **25**, 516–24 (*May*, 1953).

Solutions of the vector equation of equilibrium for an isotropic solid are presented for the special case of harmonic time dependence and dissipationless wave propagation. The object is to investigate the angular distribution and speed of wave propagation of the components of the elastic wave field at large distances R from the source, which source region is a plane surface of finite extent. Solutions are obtained for specified discontinuities of stress on an interior plane of an unbounded solid, and prescribed stresses on the bounding plane of a semi-infinite solid. Several examples are considered in which the distribution of a single stress component is selected to simulate the stress produced by a high frequency quartz piezoelectric crystal. For the high frequencies of solid delay line operation and the isotropic solids commonly used, the angular distribution of the dominant components of the elastic wave field are essentially the same for the semi-infinite and unbounded solid, to terms in R^{-1}. The speed of propagation of the dominant field is characteristic of the type of source, shear or compressional, and the angular distribution is characteristic of the configuration of the source region. A.

534.26

5348. The scattering of sound from the sea surface. C. Eckart. *J. Acoust. Soc. Amer.*, **25**, 566–70 (*May*, 1953).

It is assumed that the equation of the sea surface is $z = \zeta(xyt)$, and that the time average $\Phi = [\zeta(x'y't)\zeta(x''y''t)]$ is a function only of $\xi = x'' - x'$, $\eta = y'' - y'$. The scattering coefficient of long-wave sound is calculated and shown to be $\sigma = (c^2k^2/4\pi)^2 \int\int \Phi(\xi\eta) \exp[-ik(a\xi + b\eta)]d\xi d\eta$, where $2\pi/k$ is the wavelength of the sound, and a, b, c are, respectively, the sum of the x, y, z direction cosines of the incident and scattered rays. For short-wave sound, the formula is more complicated, but independent of the wavelength of the sound, as it should be. However, it is shown that experiments with short waves yield much less information about the sea surface than do those with long waves. This is unfortunate, since the latter experiments are much more difficult than the former. A.

534.3

5349. Recent work on violins. F. A. Saunders. *J. Acoust. Soc. Amer.*, **25**, 491–8 (*May*, 1953).

(*a*) Loudness-frequency curves of violins disclose peaks caused by natural vibrations of the body and of the inner air. "Overtone peaks" occur when a natural vibration coincides with one of the partials of the tone. Shifting the frequencies of the natural vibrations is possible and can produce a more even distribution of strength. (*b*) The volume of tone is very sensitive to the thickness of the top plate along the line where it is attached to the rest of the body. Thinning a groove part way around the top has produced marked improvements in several instruments. (*c*) The air inside the box produces one noticeable peak only in the loudness curve. Tuning forks placed in front of the *f*-holes produce responses but they are the result of body vibrations. (*d*) Experiments on *f*-holes show that long ones are somewhat better than short, and also that the main function of the bass-bar is to carry vibrations from the active foot to the bridge to the wider areas. (*e*) Resonating strings reduce loudness rather than increasing it. Interesting phase differences occur between strings, or the inner air, or parts of the body. (*f*) A string gives more tone when the others are relaxed. A.

534.31

5350. Dependence of the primary *Pfeifenton* (pipe tone) frequency on pipe-orifice geometry. A. B. C. Anderson. *J. Acoust. Soc. Amer.*, **25**, 541–5 (*May*, 1953).

See Abstr. 672 (1953). A derivation is presented of an expression relating the frequency of the *primary Pfeifentöne*, produced in a column of moving gas, to the geometry of the pipe-orifice combination in which the *Pfeifenton* oscillations occur. The *Pfeifentöne* appears to be initiated in, and by the gas discharging continuously through, the orifice. A comparison is made between the results obtained with this expression and experiment. Good agreement is shown between the values of the primary *Pfeifenton* frequencies predicted by the relation and the values obtained by experiment. These results apply for a thin orifice plate, and are expressed in nondimensional form. A.

534.321.3

5351. A scale for specifying frequency levels in octaves and semitones. P. Moon. *J. Acoust. Soc. Amer.*, **25**, 506–15 (*May*, 1953).

A new system of specifying frequency level is proposed. It utilizes the logarithm (base 2) of the relative frequency, expressed in duodecimal notation. In this way the designation of musical intervals and musical scales is related directly to frequency, yet the numbers repeat in each octave and the semitones of the equi-tempered chromatic scale are expressed exactly as 0·100, 0·200, 0·300, . . . The new notation is

pplied to the macrodesignation of semitones and octaves, and to the microdesignation of true intervals nd of Pythagorean and Ptolemaic scales. A slide ule is developed to allow easy visualization of the elations among musical intervals. A.

534.39 : 537.365 : 541.13

Ultrasonic waves and electrochemistry. I–IV. *See Abstr.* 5747–5750

534.61

5352. On the forces due to acoustic wave motion in a viscous medium and their use in the measurement of acoustic intensity. F. E. BORGNIS. *J. Acoust. Soc. Amer.*, **25**, 546–8 (*May*, 1953).

The hydrodynamic flow associated with acoustic waves in viscous fluids is usually regarded as a disturbing effect in measuring acoustic intensities by radiation pressure. It is shown, however, by a simple application of the hydrodynamic momentum theorem, that the sum of the forces due to acoustic radiation and to the hydrodynamic flow, when a beam of plane waves is incident upon an absorber, is independent of the absorption in the medium and (within considerable limits) of the distance between the acoustic source and the absorber, if certain conditions are observed. This makes it possible to measure, in a simple way, the intensity of an acoustic beam at the source by measuring the total force due to radiation and flow without knowledge of the absorption coefficient of the fluid and without the use of thin screening films, which are commonly applied in order to eliminate the flow. A.

534.7 : 612.85

Physiological acoustics. Hearing. *See Abstr.* 5824–5

534.78

5353. The control of the human voice. F. WINCKEL. *Funk u. Ton*, **3**, 124–132 (*March*, 1953) *In German.*

Describes a study of various factors controlling the human voice. The characteristic features of the vocal tract are analysed and the equivalent mechanical (acoustic) and electrical circuits described. Diagrams are reproduced showing the origins of various notes emitted from the mouth of a singer, and of the nerve connections between the throat, mouth and ear to the brain of the singer. The influence of hearing on the voice of the singer (singer's ears stopped or open) is discussed, and the effect of delayed feedback examined [see also Abstr. 1703 (1951)]. Comparisons are also made of voice production in rooms of different reverberation times T—e.g. in the studio $T = 1{\cdot}2$ sec, in a sound absorbent chamber $T < 0{\cdot}1$ sec and in a hall $T = 6$ sec. Changes of the sound energy spectrum in these rooms are illustrated. A. B. WOOD

534.781

5354. Some variables in audio spectrometry. R. W. BENSON AND I. J. HIRSH. *J. Acoust. Soc. Amer.*, **25**, 499–505 (*May*, 1953).

Measurements of the long-time average spectrum of speech are reported with the purpose of pointing out the roles of several variables. Three different sampling times of three different types of speech material are analysed with several band-width intervals. No significant differences are found among the three types of speech material nor among the three different sampling times of 30, 60 and 90 seconds. Octave, half-octave and equal-mel intervals appear to yield the same results. The only important difference between male and female speech appears in the octave 75–150 c/s. The shape of the long-time spectrum remains fairly constant from person to person, while the overall level contributes most to interpersonal variability. A discussion of the meaning of "over-all level" in this and previous reports is given. A relatively simple system for obtaining these measurements is described. A.

534.833

5355. A comparison between model study tests and field measurements on an aircraft test-cell silencer. D. B. CALLAWAY AND R. D. LEMMERMAN. *J. Acoust. Soc. Amer.*, **25**, 429–32 (*May*, 1953).

An acoustic model study was made of the silencer for a propeller engine test cell in which the acoustical treatment consisted of conventional splitters for high-frequency silencing and thick splitters designed to give low-frequency reduction. The scale chosen for the model study was $\frac{1}{8}$, and absorption coefficients of silencing treatment were simulated at frequencies eight times those of interest in the full-scale structure. After construction of the test cell, field measurements were made of the noise reduction provided by the silencing treatment, using as a sound source both a propeller engine and loudspeakers driven by a thermal noise source. Measurement of the noise reduction provided in the scale model permitted prediction of reductions in the full structure which showed reasonably good agreement with field measurements. On the basis of the model study and field measurements on high-frequency splitters, an empirical relationship between noise reduction and absorption coefficient was determined. A.

534.837

5356. The aircraft noise problem. R. H. BOLT. *J. Acoust. Soc. Amer.*, **25**, 363–6 (*May*, 1953).

Aircraft noise presents a system problem which to date has been attacked mainly at the level of individual components. The system includes: (*a*) aircraft as noise sources; (*b*) atmosphere and terrain as influences on sound propagation; (*c*) people, under several classes and conditions, as responders to noise; (*d*) physical components for controlling noise; (*e*) operating procedures for reducing noise exposure in communities; (*f*) public relations; (*g*) aviation planning policies and economics; and (*h*) many organizations concerned with characteristics and consequences of aircraft noise. The nature of these components is reviewed in a general way, with emphasis on their inherent interrelations. This discussion provides a framework for unifying the several subjects included in the present aircraft noise symposium (abstracts following). A.

534.837

5357. Physical characteristics of aircraft noise sources. H. E. VON GIERKE. *J. Acoust. Soc. Amer.*, **25**, 367–78 (*May*, 1953).

Available basic characteristics of different aircraft noise sources under the condition of zero forward speed are summarized: Total acoustic power; acoustic mechanical efficiency; directivity and frequency

characteristics are given for the rotation and vortex noise of propellers, for the exhaust noise of reciprocating engines and for different types of jet engines. The physical mechanisms underlying the different noise sources are discussed and the influence of changes in the parameters such as tip speed or pitch of the propeller and diameter or velocity of the gas jet are shown. In cases where measurements on the actual propulsion systems are incomplete, the basic physical conclusions are drawn from experiments on model airscrews and small air jets. The changes in the characteristics of the noise generators during flight are discussed briefly. A.

534.837

5358. Noise characteristics of pulse-jet engines. P. S. VENEKLASEN. *J. Acoust. Soc. Amer.*, **25**, 378–80 (*May*, 1953).

Data obtained as part of a noise control programme are presented to show the magnitude, spectral characteristics, directional properties and variation with operating conditions of the noise produced by two sizes of pulse-jet engines. A.

534.837

5359. Experimental studies of jet noise. H. H. HUBBARD AND L. W. LASSITER. *J. Acoust. Soc. Amer.*, **25**, 381–5 (*May*, 1953).

The mixing region of a jet is observed to be a complex noise generator. The noise produced is highly directional and is affected by various geometric and flow parameters as well as by conditions in the settling chamber upstream of the nozzle. Noise measurements for a family of circular model air jets ranging in diameter from $\frac{3}{4}$ to 12 inches are consistent with available data for a turbojet engine. The intensity of the fluctuating pressure field near the jet is greatest at an axial distance of approximately two diameters downstream from the nozzle exit and decrease generally with increasing distance. The frequency spectrums recorded near the jet boundary are usually peaked, the peak frequencies being higher near the jet exit than at points farther downstream. These noise frequencies generally increase with increasing jet fluid velocity and decrease with increasing jet size. Hot wire surveys of turbulence (axial velocity fluctuation) in the jet stream indicated spectra which were very similar in quality to the noise spectra recorded just outside the jet boundary and at the same axial stations. A.

534.837

5360. The noise of choked jets. A. POWELL. *J. Acoust. Soc. Amer.*, **25**, 385–9 (*May*, 1953).

The noise of a jet changes character after the pressure ratio exceeds the critical value appropriate to sonic exit velocity, the general roar being dominated by a loud "whistling" or "screeching." Schlieren photographs show that sound waves of ultrasonic frequency are caused by the transition of the initially laminar boundary layer to turbulence and also by this turbulence interacting with the shock waves of the flow. Larger disturbances have also been noted, involving both the jet stream and some of the air external to the jet, and these also give rise to sound waves which have been photographed: it is these which are held responsible for the audible effects. A two-dimensional study has shown the latter phenomenon to be enhanced, and it is shown how the system of disturbances is self-maintained by virtue of sound waves creating initially small disturbances at the jet exit. The directionality of the sound field has been predicted and found in agreement with experiment, and the dimensions of the motion are compatible with the suggested mechanism. The relation to edge-tones is pointed out and the mechanism indicated, a photograph of this phenomenon also being shown. Finally mention is made of how the characteristic noise of jets working above the critical pressure might be reduced, the suggested methods having been found successful in practice. A.

534.837

5361. On noise of aerodynamic origin. O. K. MAWARDI AND I. DYER. *J. Acoust. Soc. Amer.*, **25**, 389–95 (*May*, 1953).

An attempt is made in this paper to classify noises of various aerodynamic origin by means of an efficiency of conversion from mechanical to acoustical energy, and also by means of representative spectra associated with corresponding characteristic frequencies. The classification has been tried successfully on measurements of wind tunnel noises, turbo-jet noises and air jet noises. A.

534.837

5362. Status of research on propeller noise and its reduction. A. A. REGIER AND H. H. HUBBARD. *J. Acoust. Soc. Amer.*, **25**, 395–404 (*May*, 1953).

The basic concepts concerning the mechanism of propeller noise generation are reviewed, and equations for calculating the noise field both near and far from the propeller are given. The problem of noise due to non-steady airloads on the blades, and differences in noise from the approaching and retreating blades are discussed. Effect of tip speed, number of blades, blade thickness and blade width are considered, and it is shown that reducing the tip speed and increasing the number of blades are probably the most effective means of reducing the efficiency of noise generation and alleviating the noise problem. Noise characteristics of such special types as the supersonic, dual-rotating, tandem and shrouded propeller are also presented. Studies of propeller weight show that substantial noise reduction on transport type propellers would result in a considerable weight penalty. For the propeller-driven aircraft in the 400 to 500 m.p.h. speed range, the slower-turning quieter propeller is likely to have better propulsive efficiency than the noisier high-speed propeller. Hence, in this speed range, the weight penalty of the quieter propeller may be offset by its higher propulsive efficiency. A.

534.837

5363. Aircraft engine noise control as viewed by the engine manufacturer. D. M. HAZARD. *J. Acoust. Soc. Amer.*, **25**, 412–16 (*May*, 1953).

The aircraft engine manufacturer has been continually confronted with the factor of noise control in conjunction with the development and production testing of engines. The scope of this control activity has increased many fold during recent years as the result of the rapid growth in types and size of military power plants. Presented in this paper is a review of

the over-all control procedure including typical noise sources, control objectives, recent techniques used in the control and attenuation of aircraft powerplant noise, problems associated with the design of noise control provisions and limitations in the existing methods. This review includes data on reciprocating, turbojet, turboprop and ram jet powerplants along with a description of installations used for controlling the noise both in ducted exhaust systems and in propeller-type test cells. This discussion cites cost, space and high tolerance in design factors as being the major design problems. Areas of continued endeavour are outlined for the engine manufacturer, acoustical consultant and the noise control equipment manufacturer. A.

543.837

5364. Noise control for ground operation of the F-89 airplane. P. S. VENEKLASEN. *J. Acoust. Soc. Amer.*, **25,** 417–22 (*May*, 1953).

A noise control project is described which includes a noise muffler for the ground testing of the F-89 aeroplane which is powered by two turbojet engines. Included are the prediction of performance, acoustical design considerations, correlation of acoustical and thermodynamic requirements, general construction, acoustical tests during construction, noise survey around the exposed aeroplane and neighbourhood survey around the completed installation. This noise suppressor is comparatively simple and inexpensive, requires no water cooling even for afterburner operation and has proved adequate in terms of neighbourhood relief and protection of operating personnel. A.

534.837

5365. Noise control measures for jet engine test installations. H. C. HARDY. *J. Acoust. Soc. Amer.*, **25,** 423–8 (*May*, 1953).

The various schemes currently used for controlling the noise of aircraft engine test stands and warm-up operations on the ground are briefly surveyed. The first step is to evaluate a design goal for acceptable levels in the neighbourhood for the installation. The size of cross-section required to handle the intake and exhaust gases is determined from the amount of air consumed, the temperature, acceptable gas velocities, and the aerodynamic pressure drops. The modern trend in size of engines is such as to require cross-sections of 200 ft² or more. Several different styles of structures have been found successful. The various types used—steel mufflers, duct splitters and plenums and 180-degree bends—are discussed and typical data are given for each type. Economic considerations are emphasized. The use of scale model acoustic tests for untried acoustic designs is strongly recommended. A.

534.837

5366. Sound radiation patterns of gas turbine exhaust stacks. R. J. WELLS AND B. E. CROCKER. *J. Acoust. Soc. Amer.*, **25,** 433–7 (*May*, 1953).

Radiation patterns for gas turbine exhaust stacks have been calculated for the case of wide-band noise, assuming negligibly low gas velocities and temperatures. Both shape of stack and band width of analysing equipment are considered. Theoretical results are compared with data measured on models and on a prototype exhaust system. A.

534.837

5367. Materials and structures problems in aircraft noise control. R. D. LEMMERMAN. *J. Acoust. Soc. Amer.*, **25,** 438–41 (*May*, 1953).

The materials and structures problems associated with the construction of aircraft noise silencing systems often make classical solutions to the acoustic problems extremely difficult. The associated problems of fluid mechanics and physical construction must be carefully considered along with acoustical requirements at the time of initial design. A review of some of these problems specifically associated with various types of aircraft engines will be useful. Similarly, the various types of acoustical material suitable for broad band attenuation will be considered from their structural standpoint. A.

534.862.3 : 535.41

5368. The calibration of disc recordings by light-pattern measurements. P. E. AXON AND W. K. E. GEDDES. *Proc. Instn Elect. Engrs, III*, **100,** 217–27 (*July*, 1953).

The paper sets out an analysis, in terms of geometrical optics, of the Buchmann–Meyer, or light, pattern which is formed by reflection from the modulated grooves of a recorded tone-disk. The pattern is considered as lying in the focal plane of the circular groove walls and not on the disk surface, as is usually assumed. A new apparatus for measuring the width of the patterns is described and the errors in disk-surface and focal-plane measurements found when using it are compared. The latter results are shown to possess the higher degree of consistency and their correctness is confirmed by an examination of the pattern formation in terms of physical optics. The origin of two sets of interference fringes which are visible in the patterns is also described. The decrease of luminous intensity which occurs at the edge of the patterns is then computed and it is shown that the new method of measurement described should give a higher degree of accuracy than hitherto available, even under some practical conditions when the edge of the pattern is not sharply defined. A.

OPTICS . RADIATION . SPECTRA 535

535.14 : 535.42

5369. The theory of images and radiation. P. M. DUFFIEUX. *Cahiers de Phys., No.* 41, 55–72 (*Jan.*, 1953) *In French.*

A considerable part of our knowledge of material objects is deduced from their images, i.e. from the integration of the radiation diffracted by the object. Supposing the existence of photons, the process of image formation also yields information regarding their form, and some general properties of this form are deduced from general image theory. It is concluded that, *in vacuo*, the transform of the form of the photon of natural light is a constant within a circular domain. The function of the form of the photon is then identical with that of the diffraction figure at infinity due to a circular aperture, the so-called Airy disk. R. W. FISH

535.233

5370. Spectral emissivities of graphite and carbon. R. J. THORN AND O. C. SIMPSON. *J. appl. Phys.*, **24**, 633–9 (*May*, 1953).

The emissivities have been determined at a wavelength of 0·653 μ in the temperature range of 1285 to 2035°K and have been found to be temperature dependent in accordance with a prediction from a relation between reflectivity and resistivity. For polished graphite of high purity having a resistivity of about 1120 microhm-cm the value obtained is 0·78; the value obtained for a polished high density graphite having a resistivity of 1740 microhm-cm is 0·78; and that for polished spectroscopic carbon having a resistivity of 5080 microhm-cm is 0·79. If graphite is sublimed from a polished surface, the latter becomes roughened, so that the emissivity increases. In one particular experiment it attained a value of 0·90. A.

535.247.4 : 771.534.5 : 578.087

5371. A recording microdensitometer applicable to biological problems. P. M. B. WALKER. *J. sci. Instrum.*, **30**, 162–4 (*May*, 1953).

A servo-operated pen-recording microdensitometer is described which is particularly applicable to the measurement of densities in photographs of biological material. It is a double beam instrument, recording density directly, which allows the immediate summation of densities to give, for example, the integrated absorption due to a particular biological structure. A.

535.247.4 : 771.534.5 : 621.383 : 621.317.79

5372. A photoelectric densitometer. O. L. GOBLE. *J. sci. Instrum.*, **30**, 110–13 (*April*, 1953).

An a.c. operated self-balancing photoelectric densitometer is described. It measures photographic density over a range of 0–3, and has reproducibility and sensitivity of better than 0·01 over the entire range. A pair of emissive photoelectric cells are employed, and the measurement is made by a wedge substitution method. Special features are the employment of a high-speed telegraphic relay for the conversion of the photoelectric currents into 50 c/s a.c. and the use of a 2-ph. servomotor for self-balancing. The system gives high sensitivity, freedom from zero drift, while the simplicity of operation and rigid construction make this densitometer suitable for factory use. A.

535.3

5373. A new treatment of reflection and total reflection. M. TOEPLER. *Wiss. Z. Tech. Hochsch. Dresden*, **1**, *No.* 3, 277–92 (1951–52) *In German.*

A rather novel approach, which aims at giving a clear picture of the physical processes involved.

P. M. DAVIDSON

535.31 : 535.8

5374. On the simultaneous fine-correction of the aberrations in optical systems. F. FREITAG. *Optik*, **9**, 529–43 (1952) *In German.*

The formulae for ray-tracing are given in vector form. The method of Wagner [*Arch. Math.*, **1**, 4, (1948)] is then used to obtain the derivatives of the transverse aberration of a ray with respect to constructional variables. There results a system of simultaneous linear equations, whose solution may be effected using an electromagnetic analogue computer. An example is quoted, and computing times have been determined. These latter were found to be long on account of the matrix multiplication in the formulae for the differential coefficients. H. H. HOPKINS

535.312

5375. On the extension of the range of applicability of ray theory to the propagation of waves in stratified media. L. M. BREKHOVSKIKH AND I. D. IVANOV. *Dokl. Akad. Nauk SSSR*, **83**, *No.* 4, 545–8 (1952) *In Russian.*

The author compares the signal received at a point from a point source by reflection at a boundary between two media with the case of a gradual transition from one medium to the other. It is shown that it is not possible to use geometrical optic methods in the general case but that they are the limiting case for grazing incidence. J. M. HOUGH

535.315

5376. On the resolving power of a prism. K. MAJUMDAR AND M. S. SODHA. Note in *Amer. J. Phys.*, **21**, 387–8 (*May*, 1953).

The resolving power of a prism in positions other than minimum deviation is determined. The resolution is shown to be a maximum at minimum deviation and a minimum at normal incidence or emergence. The dispersive power is found from Hartmann's dispersion formulae. R. W. FISH

535.317

5377. A common method of definition of the parameter of the heterogeneous medium for a given beam path. A. L. MIKAÉLYAN. *Dokl. Akad. Nauk SSSR*, **83**, *No.* 2, 219–20 (1952) *In Russian.*

After stating the principle of least time, discusses the solution of Euler's equation and the distribution of phase and intensity in the beam. W. BARDSLEY

535.317 : 535.824

5378. Contribution to the study of certain problems of microscopy. A. BLANC-LAPIERRE, P. DUMONTET AND M. PERROT. *J. Phys. Radium*, **14**, 83S–84S (*Jan.*, 1953) *In French.*

The object-image correspondence in an optical system is considered to be a linear filter with a limited frequency pass-band. This view allows information theory to be applied to an optical system. It is possible to discern the presence of an object with spatial frequencies outside the pass-band by using a frequency changer. R. W. FISH

535.317.4 : 535.824.2

5379. A study of the combined effects of aberrations and a central obstruction of the pupil on the contrast of an optical image. Application to microscope objectives using mirrors. I–II. W. H. STEEL. *Rev. Opt.*, **32**, 4–26 (*Jan.*); 143–78 (*March*, 1953).

I. Considers the images formed by a perfect instrument with incoherent illumination. By integration from a point image, the image forms are calculated for a line, an edge and for parallel line resolution charts. The effect of coherent illumination is considered.

II. Introduces aberrations by an approximation method and the amount of aberration is found which reduces the contrast by 0·2 for various annular apertures. Values are found for lines and resolution charts for different object sizes and obstruction ratios.

R. W. FISH

535.323 : 535.345 : 548.0

5380. Determination of the optical parameters of uniaxial crystals by reflected light. F. I. FEDOROV. *Dokl. Akad. Nauk SSSR*, **84**, 1171–4 (1952) *In Russian.*

535.33.07

5381. A photoelectric spectrograph with double beam and high resolution. J. BROCHARD AND P. JACQUINOT. Letter in *J. Phys. Radium*, **14**, 131–2 (*Feb.*, 1953) *In French.*

The optical set-up, with polarizing devices and servomechanism, and the electrical system with chopper and cathode-ray recorder, are described. A diagram is given. With the liquid-prism spectrograph a resolving power of 200 000 is attainable in the blue, even with weak light sources. A. G. GAYDON

535.338 : 535.89

5382. A light source which emits a continuous spectrum. L. HERMAN AND R. HERMAN. *Cahiers de Phys.*, *No.* 42, 75–80 (*March*, 1953) *In French.*

Describes measurements made on the continuous spectrum of argon at about 10 mm Hg pressure for wavelengths varying from 3000 to 5400 Å. The intensity variation is also given. Excitation was produced by a high voltage a.c. source. The continuum is interpreted as being of molecular origin; a free-free transition mechanism was rejected since spark lines were not observed. J. D. CRAGGS

535.338 : 535.615

5383. Observation of forbidden components in the Zeeman effect, caused by nuclear spin. J. BROCHARD AND P. JACQUINOT. Letter in *J. Phys. Radium*, **14**, 132–3 (*Feb.*, 1953) *In French.*

It is shown how from the intensity of these components one could deduce the h.f.s. constant and the nuclear spin. The forbidden lines were in fact detected in the case of the yellow line of Na, but the method may find practical application only if much more intense sources become available. L. PINCHERLE

535.338.4–31

5384. On the emission bands of the NO molecule in the vacuum ultraviolet region. Y. TANAKA. *J. chem. Phys.*, **21**, 788–93 (*May*, 1953).

The NO emission spectrum in the far-ultraviolet region was investigated with 85 cm and 21-foot normal-incidence vacuum spectrographs. The existence of the ε-system is confirmed. The β' bands are reinvestigated, and a curious appearance was observed in the (4, 0) band. New bands which have an appearance similar to the β' bands are observed in the region of 1500 Å, and tentative analysis is made. A.

535.343–14

5385. Radiowave spectroscopy. C. J. GORTER. *Experientia*, **9**, *No.* 5, 161–75 (1953) *In French.*

The differences between radiowave spectroscopy and the usual optical spectroscopy are discussed, and afterwards the early history and development of the different branches of radiowave spectroscopy are recalled. In the following sections three branches of radiowave spectroscopy, on which research is proceeding in the Kamerlingh Onnes Laboratory at Leyden, are considered in some detail. A review is presented of experiments on nuclear magnetic resonance (nuclear induction) in solids and liquids. An introduction is given to the interrelated topics of paramagnetic relaxation and paramagnetic resonance. There is a provisional account of radio-wave spectroscopical work on antiferromagnetic crystals of $CuCl_2 . 2H_2O$. A.

535.343–15 : 539.13

5386. Infrared absorption of N_2 and O_2 induced by intermolecular forces. R. COULON, B. OKSENGORN, S. ROBIN AND B. VODAR. Letter in *J. Phys. Radium*, **14**, 63 (*Jan.*, 1953) *In French.*

The 2331 cm^{-1} band of N_2 is measured for pressures between 200 and 900 atm., and a graph of ε/d^2 as a function of wavenumber shows the same profile for all pressures. ε is not proportional to d^2 for O_2, which might be due to formation of O_4 at high pressures. C. TURNER

535.343–15

5387. Attempt to interpret absorption spectra in the near infrared. I. Aliphatic saturated hydrocarbons. G. GAUTHIER. *J. Phys. Radium*, **14**, 19–24 (*Jan.*, 1953) *In French.*

The i.r. spectra of 10 saturated aliphatic hydrocarbons are taken between 0·8 and 1·9 μ in the liquid phase. The apparatus is described in detail. Series of strong bands are observed, caused by the CH, CH_2 and CH_3 groups. These experimental values show good agreement with values calculated by Kratzer's formulae, except for the first harmonic 2ν. In order to explain this it is assumed that resonance occurs between the fundamental valence vibration and the first harmonic of the deformation vibration. The less intense bands can be explained as combination frequencies. From these data it is possible to calculate those fundamental vibrations which occur in the range of longer wavelengths.

A. J. TAYLOR

535.343–15

5388. Attempt to interpret absorption spectra in the near infrared. II. Benzene. G. GAUTHIER. *J. Phys. Radium*, **14**, 83–8 (*Feb.*, 1953) *In French.*

See also preceding abstract. With a spectrograph of high dispersion power about forty new bands were found between 0·8 and 1·9 μ in liquid benzene. The spectrum analysis is given: each frequency can be explained as a combination of fundamental frequencies and harmonics, in such a way that the symmetry D_{6h} can also be maintained in the liquid phase. All vibrations are of the type E_u or A_{2u}, though forbidden frequencies sometimes occur also; these can be explained by deformations during vibrations, when the symmetry is lower temporarily.

A. J. TAYLOR

535.343.2

5389. Absorption of light by a cuprous oxide crystal in the infrared and visible spectra. E. F. GROSS AND N. A. KARRYEV. *Dokl. Akad. Nauk SSSR*, **84**, *No.* 2, 261–4 (1952) *In Russian.*

Cu_2O, produced in layers of various thicknesses by oxidation of electrolytic Cu, shows, at room temp., i.r. absorption bands with peaks at 8·9 and 12·6 μ, displaced to 8·7 and 12·4 μ at −100°. These are ascribed to low-energy electronic transitions within groups of levels in the neighbourhood of the upper zone and the oxygen acceptor level; the energies are 0·14 and 0·1 eV, which is the order of those predicted

from the temp. dependence of the conductivity of Cu_2O. In the visible region near to the main absorption band at room temp., the absorption curve shows a small upward jump at 6371 Å, and a larger one at 6284 Å, ending at about 6040 Å; all these positions move towards shorter waves as the temperature is reduced, although the distance between them does not change. There is a group of 7 lines on the continuous background located, at −200°c, at 6125·3, 5792·7, 5766·6, 5743·8, 5738·1, 5734·1 and 5731·7 Å; $\Delta\nu_k = 785\ \text{cm}^{-1}/k^2$, where $k = 1, 2 \ldots 7$. These are ascribed to transitions between the groups of local levels responsible for the i.r. absorption bands. It is possible that the stepwise absorption may be caused by interaction of electrons with oscillating ions in the lattice. R. C. MURRAY

535.343.2

5390. Optical spectrum of overtone [electrons]. E. F. Gross and N. A. Karryev. *Dokl. Akad. Nauk SSSR*, **84**, *No.* 3, 471–4 (1952) *In Russian.*

A more detailed study has been made of the series of sharp lines in the visible absorption spectrum of Cu_2O, previously reported (preceding abstract). Their similarity to atomic spectral lines indicates overtone electrons as their source, which is confirmed by the fact that the formula for the frequency succession of the lines agrees in form with that predicted by Dȳkman and Pekar [Abstr. 5779 (1953)] for the hydrogen-like spectrum of overtone electrons. The energy of formation of the overtone electrons in Cu_2O is calculated from the absorption wavelengths to be 2·014 eV, and their photo-dissociation energy to be 2·154 eV. CdS also shows a stepwise increase of absorption in the visible, with a superimposition on the continuum of a sharp line at 4869 Å and a diffuse one at 4858–64 Å, near to the long-wave boundary of the main absorption. These features are also considered to be produced by overtone electrons, and such absorption to be characteristic of all ionic crystals. R. C. MURRAY

535.343.2 : 535.37

5391. Some optical properties of potassium iodide–thallium phosphors. P. H. Yuster and C. J. Delbecq. *J. chem. Phys.*, **21**, 892–8 (*May*, 1953).

The absorption spectra of potassium iodide–thallium phosphors have been studied at both liquid nitrogen and liquid helium temperatures. Eight absorption bands have been observed which are due to the presence of thallium. The maximum absorption coefficients of four of these bands appear to vary linearly, while the other four appear to vary with the square of the thallium concentration. The origin of these bands is discussed in terms of an extension of the model proposed by Seitz. A.

535.343.2–14 : 548.7

5392. Preliminary data on relationships between lattice defects and ultra-Hertzian absorption in iron oxides. R. Freymann, R. Bohmer and B. Hagene. Letter in *J. Phys. Radium*, **14**, 130–1 (*Feb.*, 1953) *In French.*

Numerous maxima of Debye have been found in absorption curves ($\log \varepsilon''$ plotted against $1/T$), the curves obtained being roughly assembled in 2 groups: for mixtures Fe_3O_4–Fe_2O_3 and for those FeO–Fe_3O_4. F. LACHMAN

535.343.2–15 : 537.312.5

5393. Optical and photoelectric properties of microcrystalline layers of lead sulphide in the visible and infrared. P. Vernier. *J. Phys. Radium*, **14**, 175–9 (*March*, 1953) *In French.*

A description of experimental results and methods for production and measurement of PbS layers supported on sapphire. Transmission spectra are measured from 0·5–6 μ for different thicknesses. Correlation between absorption spectra and layer sensitivity is discussed. G. F. J. GARLICK

535.343.2–31

5394. Absorption spectrum of solid nitric oxide between 2400 and 1600 Å. J. Granier-Mayence and J. Romand. *C.R. Acad. Sci.* [*Paris*] **236**, 1148–51 (*March* 16, 1953) *In French.*

A solid film at 20°K shows a structureless band with a peak at 2100 Å. This is attributed to the associated molecule N_2O_2. G. F. LOTHIAN

535.343.4

5395. Study of the variation of the intensity of visible bands of oxygen, compressed up to 1300 kg/cm², as a function of pressure. J. Robin and S. Robin. *C.R. Acad. Sci.* [*Paris*] **236**, 792–5 (*Feb.* 23, 1953) *In French.*

The absorption bands of 4770, 5773 and 6299 Å are investigated under pressures varying from 150 up to 1300 kg cm^{-2}. The maxima of the bands are not shifted with increased pressure. From 100 atm. up to 1000 atm. there is no difference in the envelopes of the bands, but above that pressure a slight change is observed which originates with $(O_2)_2$, formed by collisions of oxygen molecules. The square roots of the extinction coefficients of the maxima increase faster than the density and slower than the pressure. A. J. TAYLOR

535.343.4–14 : 539.132

5396. The microwave spectrum of arsenic trifluoride. P. Kisliuk and S. Geschwind. *J. chem. Phys.*, **21**, 828–9 (*May*, 1953).

The spectrum is re-examined under high resolution permitting the evaluation of small interactions due to centrifugal distortion and $I \cdot J$ effects, as well as a more precise determination of the rotational constant and quadrupole interaction. The constants determined are: $B = 5878{\cdot}971 \pm 0{\cdot}002$ Mc/s, $(eqQ)_{As} = -236{\cdot}23 \pm 0{\cdot}05$ Mc/s, $D_{JK} = -9 \pm 2$ kc/s, $a = -6 \pm 7$ kc/s, $b = 6 \pm 2$ kc/s, $\alpha_2 = -5 \pm 1$ Mc/s and $\alpha_4 = -0{\cdot}16 \pm 0{\cdot}04$ Mc/s. In addition, the bond angle is estimated from the quadrupole interaction by means of a comparison with $AsCl_3$, yielding $\angle F - As - F = 102° \pm 2°$. A.

535.343.4–15 : 539.133

5397. The infrared spectrum and the structure of the molecule SiH_3Cl. A. Monfils. *C.R. Acad. Sci.* [*Paris*] **236**, 795–6 (*Feb.* 23, 1953) *In French.*

Results previously recorded by the author [Abstr. 4276 (1951)] are modified and extended. Assignations of the observed bands are made, and the interatomic distances Si–H and Si–Cl and the bond angle Si–H–Si determined. Vibration force-constants were also calculated. G. I. W. LLEWELYN

535.343.4–15 : 539.133

5398. Rotation-vibration spectra of diatomic and simple polyatomic molecules with long absorbing paths. X. The spectrum of tri-deuteromethane in the photographic infrared. L. F. H. BOVEY. *J. chem. Phys.*, **21**, 830–6 (*May*, 1953).

For Pt IX, see Abstr. 3141 (1953). The absorption spectrum of CD_3H has been investigated under high resolution in the photographic infrared with absorbing paths of up to 7 m atmos. obtained by multiple reflection. Two simple parallel bands were observed at 8870 and 11 590 Å. The *K* structure in the former was clearly resolved. The rotational structure of the two bands was analysed, yielding $B_0 = 3{\cdot}278_7 \pm 0{\cdot}001_0\,cm^{-1}$. On the assumption of tetrahedral symmetry for the CD_3H molecule this value leads to a C–H distance $r_0 = (1{\cdot}0919_3 \pm 0{\cdot}0001_7) \times 10^{-8}$ cm. This value is compared with the corresponding values obtained by other authors from studies of CH_4 and CH_3D. A.

535.345

5399. Spectral location of the absorption due to color centers in alkaline earth halide crystals. H. F. IVEY. Letter in *Phys. Rev.*, **89**, 322 (*Jan.* 1, 1953).

535.371

5400. Duration of excitation states of some phosphors. K. V. SHALIMOVA AND T. P. BELIKOVA. *Dokl. Akad. Nauk SSSR*, **82**, *No.* 5, 713–16 (1952) *In Russian.*

An attempt to show that the life-time in the excited state in phosphors is related to that in the free activator atoms or ions if the emission is related to forbidden transitions. Examples are drawn from the phosphors KI : Tl, CsCl : Tl, ZnO : Zn, ZnS : Zn, CdI_2 : Cd, AgCl : Ag, AgBr : Ag, $CuCl_2$: Cu and CuI_2 : Cu. J. EWLES

535.371

5401. Polarization of the fluorescence of organic crystals. N. D. ZHEVANDROV. *Dokl. Akad. Nauk SSSR*, **83**, *No.* 5, 677–80 (1952) *In Russian.*

Crystals of 15 compounds (anthracene and some of its derivatives; derivatives of phthalimide; carbazole; salicylic acid; uranyl sulphate) have been investigated in an apparatus consisting of a microscope and a Cornu polarimeter. The degree of polarization does not depend on the shape and size of the crystals and does not diminish when the crystal is placed in an immersion medium (glycerol, immersion oil). The results of measurements of the degree (%) of polarization are tabulated; their values are considerably less than 100%. The value for anthracene (39%) is discussed in connection with its known crystal lattice. It has been also found that the polarization of fluorescence is independent of the polarization of the exciting light. F. LACHMAN

535.371

5402. Characteristics of phosphors with sulphate bases. M. A. KONSTANTINOVA-SHLEZINGER, H. A. GORBACHEVA AND E. I. PANASYUK. *Zh. eksper. teor. Fiz.*, **23**, *No.* 5 (11), 588–92 (1952) *In Russian.*

Preparation of phosphors. Decay curves and glow curves of $PbSO_4$. Sm with different fluxes. Glow curves of $CdSO_4$ with Mn, Pb and Mn + Pb activation, and of $PbSO_4$ with the two activators Sm and Ce. J. EWLES

535.371

5403. Study of the infrared photoluminescence of copper-activated cadmium sulphide. E. GRILLOT AND P. GUINTINI. *C.R. Acad. Sci.* [*Paris*] **236**, 802–4 (*Feb.* 23, 1953) *In French.*

The luminescence emission of CdS–Cu consists of a broad band from 0·7–1·4 μ with maximum at 1·02 μ. Analogies exist between the energy states due to copper and silver in CdS and those already known for ZnS. G. F. J. GARLICK

535.371

5404. A theory of sensitized luminescence in solids. D. L. DEXTER. *J. chem. Phys.*, **21**, 836–50 (*May*, 1953).

The term "sensitized luminescence" in crystalline phosphors refers to the phenomenon whereby an impurity (activator or emitter) is enabled to luminesce upon the absorption of light in a different type of centre (sensitizer or absorber) and upon the subsequent radiationless transfer of energy from the sensitizer to the activator. The resonance theory of Förster, which involves only allowed transitions, is extended to include transfer by means of forbidden transitions which, it is concluded, are responsible for the transfer in all inorganic systems yet investigated. The transfer mechanisms of importance are, in order of decreasing strength, the overlapping of the electric dipole fields of the sensitizer and the activator, the overlapping of the dipole field of the sensitizer with the quadrupole field of the activator, and exchange effects. These mechanisms will give rise to "sensitization" of about 10^3–10^4, 10^2 and 30 lattice sites surrounding each sensitizer in typical systems. The dependence of transfer efficiency upon sensitizer and activator concentrations and on temperature are discussed. Application is made of the theory to experimental results on inorganic phosphors, and further experiments are suggested. A.

535.371

5405. Luminescent scintillations in the alkali iodides. J. BONANOMI AND J. ROSSEL. *Helv. phys. Acta*, **25**, *No.* 7, 725–69 (1953) *In French.*

The following characteristics of luminescent scintillations produced by γ-rays and α-particles in pure and Tl-activated alkali iodides have been measured between 77° and 290°K: (*a*) Decay law of the light pulses. (*b*) Decay times ($10^{-7} < \tau < 10^3$ sec). (*c*) Glow-curves. (*d*) Luminescent yield. The results could be interpreted quantitatively in terms of a model of luminescent centre which describes the process as a monomolecular one and allows consistent determinations of the activation energy of the metastable state of the centre. Comparison of the behaviour of activated and unactivated crystals suggests that the action of Tl is limited to the trapping function of the centre and the associated non-radiative transition, the emission process being left nearly unperturbed. A.

535.371 : 539.89

5406. Optical properties of gases at high temperatures and super-high pressures. YU. N. RYABININ, N. N. SOBOLEV, A. M. MARKEVICH AND I. I. TAMM. *Zh. eksper. teor. Fiz.*, **23**, *No.* 5 (11) 564–75 (1952) *In Russian.*

The luminescence of argon heated to a temperature of several thousand degrees by the method of adiabatic

compression [Abstr. 5741 (1953)] has been studied. It was established that the observed line and band spectra are produced mainly by the luminescence of N_2, which is an impurity in the argon, and by NO and OH produced during the adiabatic compression from other impurities. When the density and temperature of the gas are increased, the intensity of the continuous spectrum increases faster than that of the discrete spectrum. It is shown that in the ultraviolet region the distribution of the energy in the continuous spectrum may be described by the Wien formula with a single colour temperature. The colour temperature of argon is measured in its dependence on the pressure, at pressures varying from 2000 to 5500 kg/cm² and temperatures from 4000° to 9000°K. Photographs of spectra are given. E. RABKIN

535.375.5

5407. Spectra of the combination scattering of mixed crystals of some organic substances. A. V. KORSHUNOV AND V. A. SEL'KIN. *Zh. eksper. teor. Fiz.*, **23**, *No.* 5 (11) 576–83 (1952) *In Russian.*

The spectra of the combination scattering (Raman spectra) of mixed crystals of paradichlorbenzene–paradibrombenzene and parachlorphenol–parabromphenol were studied. The assumption is proposed that in some cases there is a correspondence between the structure of the lattices of the various crystals and their low frequency spectra of combination scattering. For example, a 50–50 parachlorphenol–parabromphenol crystal gives a spectrum considerably different from spectra of either of the components, even though they form a mixed crystal. It is concluded that formation of a mixed crystal at any compositions does not always serve as a criterion of isomorphism.

E. RABKIN

535.375.5

5408. Low frequency spectra of combination scattering of the crystals of parachlorphenol, parabromphenol and of their mixed crystals. A. V. KORSHUNOV. *Dokl. Akad. Nauk SSSR*, **86**, *No.* 4, 695–6 (1952) *In Russian.*

Parachlorphenol and parabromphenol have identically constructed molecules. The experiments carried out showed that these substances may form mixed crystals of any specified percentages of the components. However, the experimental results showed that there is no similarity in the low-frequency spectra of combination scattering (Raman spectra) of these substances. In addition, the lines of the low-frequency spectrum of parachlorphenol are considerably broader than those of the parabromphenol crystal. The spectrum of, e.g., 80% parachlorphenol–20% parabromphenol crystals resembles very closely the spectrum of parachlorphenol crystal with a displacement of the lines towards lower frequencies. In the spectrum of 80% parabromphenol–20% parachlorphenol there is a displacement of lines towards higher frequencies as compared to parabromphenol. Tables of spectra are given for mixtures of the components containing 100, 80, 50 and 20% of either.

E. RABKIN

535.375.5

5409. The anomalies of polarization and the variations of frequency of Raman lines. R. SOULMAGNON. *C.R. Acad. Sci.* [*Paris*] **236**, 796–9 (*Feb.* 23, 1953) *In French.*

The general factors governing the propagation of elastic vibrations in a crystal are discussed and equations are derived for the anomalies of polarization and frequency-variations of Raman lines.

G. I. W. LLEWELYN

535.375.2

5410. On the vibrational Raman spectrum of gaseous ethylene. B. P. STOICHEFF. Letter in *J. chem. Phys.*, **21**, 755–6 (*April*, 1953).

From observations on gaseous C_2H_4 at a pressure of 2 atmos., the frequency of the Raman-active fundamental $\nu_5(b_{1g})$ is shown to be about 3000 cm^{-1}. Assignments are made for the other observed bands, and these conclusions are tested by determination of the positions of the corresponding bands for the C_2D_4 molecule. G. I. W. LLEWELYN

535.375.5 : 541.65

5411. Raman effect and its chemical applications. Twenty-five years in retrospect. S. V. ANANTAKRISHNAN. *Curr. Sci.*, **22**, 63–8 (*March*, 1953).

535.375.5.083

5412. A self-registering apparatus with high resolution for Raman spectrography. M. DUPEYRAT. Letter in *J. Phys. Radium*, **14**, 131 (*Feb.*, 1953) *In French.*

Details of the optical and electronic components of the experimental arrangement are given.

G. I. W. LLEWELLYN

535.376

5413. On the mechanism of electroluminescence. D. CURIE. Letter in *J. Phys. Radium*, **14**, 135–6 (*Feb.*, 1953) *In French.*

535.376

5414. Initial rise of the brightness of electroluminescent products under the action of an alternating field. F. VIGEAN. *C.R. Acad. Sci.* [*Paris*] **236**, 1151–3 (*March* 16, 1953) *In French.*

The initial rise of electroluminescence is rapid, but several minutes are required for the max. value to be reached. An explanation is suggested in terms of electron traps and donor levels. S. T. HENDERSON

535.377

5415. Thermoluminescence as a research tool. F. DANIELS, C. A. BOYD AND D. F. SAUNDERS. *Science*, **117**, 343–9 (*April* 3, 1953).

A review of researches using thermoluminescence as an aid to study of luminescent mechanisms, analysis of minerals, surface catalysis, radiation damage and chronology of geological formations. G. F. J. GARLICK

535.39

5416. Measurement of the reflection factor of a lens of silica containing mercury vapour in the region of the resonance wavelength λ2537 Å. R. LENNUIER AND J.-L. COJAN. *C.R. Acad. Sci.* [*Paris*] **236**, 1146–8 (*March* 16, 1953) *In French.*

Radiation issuing from a hyperfine monochromator is used to determine the reflection coefficient within the spectral range of λ2537 Å, as a function of the pressure of the Hg vapour. The curves of reflection coefficient reveal the presence of a structure.

R. W. FISH

535.417

5417. On the application of the modulation method in optical interferometry. G. S. GORELIK. *Dokl. Akad. Nauk SSSR*, **83**, *No.* 4, 549–52 (1952) *In Russian.*

Recent advances in optical interferometry, e.g. multiple beam techniques, have led to increased resolving power. The author claims that a comparable advance has been made by applying the modulation methods familiar in radio interferometry [I. L. BERSHSTEIN, *Dokl. Akad. Nauk SSSR*, **75**, *No.* 5, 635 (1950); Abstr. 1984B (1951)] to an optical model. A light source is made to give interference over two different optical paths, the resultant intensity distribution falling on to a photocell whose output can be electrically filtered. If one of the path lengths is varied periodically the amplitude of the change can be measured. Periodical variations of intensity in the source can likewise be measured. The first effect has applications in the measurement of small amplitudes of vibration and the second effect in the measurement of small changes of intensity in spectroscopy. An analysis of the output from the photocell and filter is given but no figures for sensitivity, etc., are given.

W. BARDSLEY

535.417 : 534.13

5418. Investigation of vibrations, very small in comparison with the wavelength of light, by means of an harmonic analysis of the modulated interference picture. I. YA. BRUSIN, G. S. GORELIK AND S. A. PIKOVSKIĬ. *Dokl. Akad. Nauk SSSR*, **83**, *No.* 4, 553–6 (1952) *In Russian.*

In a discussion of the recent use of two-beam fringe systems by Russian investigators, the accepted analysis of the vibrating fringe system is given. Mention is made of the increased sensitivity of multiple-beam fringes [Abstr. 3407 (1951)].

W. BARDSLEY

535.42

5419. On a problem of diffraction. V. A. SVEKLO. *Dokl. Akad. Nauk SSSR*, **83**, *No.* 1, 51–4 (1952) *In Russian.*

A uniform isotropic elastic plane is examined, having a slit $y = 0$, $x > 0$; it consists of two half-planes $y \gtrless 0$ which have different elastic properties with $y = 0$, $x < 0$ as boundary. The problem of diffraction perturbation concentrated inside a region surrounding the slit is solved under certain conditions.

J. JACOBS

535.42

5420. The "enlarged pinhole." P. M. DUFFIEUX. *J. Phys. Radium*, **14**, 82S–83S (*Jan.*, 1953) *In French.*

A short note on the light distribution obtained with a system comprising a layer of absorbent material, optically neutral, in contact with the curved surface of a plano-convex lens. It is of interest in connection with calculations involving Gauss error function and Hermite functions.

E. H. DOCK

535.42 : 534.26

5421. Diffraction of waves on a rough surface. I. General theory. L. M. BREKHOVSKIKH. *Zh. eksper. teor. Fiz.*, **23**, *No.* 3 (9) 275–88 (1952) *In Russian.*

Previous attempts at solving this difficult problem, dating back to Rayleigh, oversimplified it by treating either only the case of normal incidence, or by assuming the average deflections of the rough surface from a plane as small compared with the wavelength. The author bases his approximate method only on the assumption that the radius of curvature at any point of the surface $\gg$ wavelength, a condition satisfied in many cases of practical interest, the character of the roughnesses and the nature of the medium bounded by the surface remaining otherwise quite arbitrary. In the case of acoustic waves the treatment by the usual methods of potential theory does not meet with any particular difficulties, the procedure being more or less formal and the particular form of the surface entering only into the ultimate determination of the Fourier coefficients of the expansion used in the solution. The case of electromagnetic waves, though much more complicated, is methodologically hardly different, the mutual relation of the two cases being essentially that of determinations of scalar and vector potentials, respectively. The author points out that his treatment corresponds to Kirchhoff's classical approximate method of determining optical diffraction by Green's theorem, where the field at the surface of integration is determined by an approximation of geometrical optics without considering the physical diffraction effects. In both the acoustic and electromagnetic cases the field of the diffracted waves may be decomposed into aggregations of plane waves, i.e. spectra of various orders. Their complex amplitudes may be determined by various methods. A simple relation existing between these amplitude coefficients proves the transverse character of the waves. The last two sections of the paper deal with the specific form of the law of conservation of the energy (using a somewhat generalized Rayleigh method), and the limits of application of the method, as well as an extension of its validity to the case of "overshadowing."

B. F. KRAUS

535.42 : 534.26

5422. Diffraction of waves on a rough surface. II. Applications of the general theory. L. M. BREKHOVSKIKH. *Zh. eksper. teor. Fiz.*, **23**, *No.* 3 (9), 289–304 (1952) *In Russian.*

The theory evolved in Pt I is applied to a number of concrete cases of diffraction of sound and electromagnetic waves on wavy surfaces. The finite size of the area is considered. The main examples given are based on a sinusoidal wave as cross-section of the diffracting surface and the results are obtained by various methods. More complicated shapes of the cross-section are obtained by superposing sinusoids of different amplitudes and periods. The many graphs of possible variants give a clear illustration of the principal character of the phenomena observed on surfaces of very appreciable roughness contrasted with almost-smooth surfaces.

B. F. KRAUS

535.42 : 534.26

5423. Scatter [diffraction] of waves on a statistically rough surface. M. A. ISAKOVICH. *Zh. eksper. teor. Fiz.*, **23**, *No.* 3 (9) 305–14 (1952) *In Russian.*

A method is given for calculating the field scattered on an absolutely reflecting statistically-rugged surface, the ruggednesses of which are $\gg$ wavelength. It is

assumed that the incident wave is plane and the scattered field is observed in the Fraunhofer zone. The problem is solved in the Kirchhoff approximation, i.e. it is assumed that the field may be represented at any point of the surface as the sum of the incident wave and a wave reflected on a tangential plane to the surface at the given point. "Overshadowing" of individual parts of the surface by others is excluded, and secondary scatter, i.e. multiple reflections on the surface, is not considered. These limitations imply others imposed on the curvature and angle of slope of the surface. On the other hand, they are also equivalent to postulating fairly strong correlation between the relative displacements of the points of the surface from the main plane. This condition is assumed to be satisfied and also that the dimensions of the scattering plane are $\geqslant$ radius of correlation. Whilst the actual calculations are carried out for acoustic waves, the last section shows that extension to electromagnetic waves presents no systematic difficulties except transition from a scalar to a vector potential field. B. F. KRAUS

535.421

5424. Phase contrast measurements of the ruling structure of optical gratings. II. E. INGELSTAM AND E. DJURLE. *Ark. Fys.*, **6**, *Paper* 44, 463–76 (1953).

For Pt I, see Abstr. 5055 (1952). This paper reports technical improvements, and includes a more extensive theoretical treatment. The methods are suitable for the study of gratings of intermediate and large size, and allow a true phase map of the emergent wavefronts to be built up. A standard test procedure, using only simple accessories, is briefly described. R. W. FISH

535.43

5425. Molecular scattering of light in liquids. G. P. MOTULEVICH AND I. L. FABELINSKIĬ. *Dokl. Akad. Nauk SSSR*, **83**, *No.* 2, 203–6 (1952) *In Russian.*

The discrepancy between the experimental values of the scattering coefficient and those calculated using Einstein's formula embodying $\left(\rho\frac{\partial\varepsilon}{\partial\rho}\right) = \alpha$ (where ρ is density, and ε the dielectric constant) is attributed to the use of static α, not suitable for light-scattering phenomena. Better agreement between theory and experiment is obtained when α is determined from diffraction of light by ultrasonic waves by the authors' method [Abstr. 5435, 8746 (1952)], giving dynamic adiabatic values of α_S, from which the isothermic values (α_T) are calculated by using the known thermodynamical relations. These values for H_2O, CH_3OH, C_2H_5OH, $(C_2H_5)_2O$, C_6H_6, $C_6H_5CH_3$ and $C_6H_4(CH_3)_2$ are compared with those calculated from the formulae of King and Lorenz–Lorentz. Best agreement with the experimental scattering coefficient and Einstein's formula is obtained with dynamic α values determined in the above way; static values give unexplained systematic discrepancies. Agreement of experiment with the King and Lorenz–Lorentz formulae is occasional. F. LACHMAN

535.43 : 548.7

Molecular theory of the Rayleigh scattering in crystals. *See Abstr.* 5777

535.436 : 539.133

5426. Study of the depolarization of scattered light by molecular chains. H. BENOIT. *C.R. Acad. Sci.* [*Paris*] **236**, 687–9 (*Feb.* 16, 1953) *In French.*

The relations of Cabannes, derived for the depolarization of light by anisotropic molecules, can be used for molecules consisting of a number of identical chain elements, on condition that the molecule is small with respect to the wavelength. The anisotropy is expressed as a function of the anisotropy of the monomer and the statistical properties of the chain. An application to aliphatic chains is described for free as well as restricted rotation round the C–C axes. A. J. TAYLOR

535.55 : 539.132

5427. Molecular interpretation of the strain-optical constants of sodium chloride. P. MARCK AND L. TAUREL. *J. Phys. Radium*, **14**, 8–13 (*Jan.*, 1953) *In French.*

Mathematical analysis and calculation of the variation of polarizability of the Cl ion when NaCl undergoes a static deformation, expressed as a function of the strain-optical constants of Pockels. F. LACHMAN

535.56 : 539.132

5428. The theory of Kuhn of the natural rotatory power. P. LOUDETTE. *J. Phys. Radium*, **13**, 65S–67S (*Dec.*, 1952) *In French.*

Born has established (1933) that rotatory power is proportional to a constant of gyration g, which, in the general case, cannot be calculated. To find g it is necessary to formulate a simple hypothesis and molecular model as in Kuhn's theory (1932). Details of this are given and particular reference made to the application of Born's calculations to the Kuhn model as indicated by Mathieu (1946). H. G. JERRARD

535.563 : 548.0

5429. Circular dichroism in crystals. M. V. VOL'KENSHTEĬN AND É. K. BYUTNER. *Zh. eksper. teor. Fiz.*, **23**, *No.* 5 (11) 584–7 (1952) *In Russian.*

By means of a classical model of a system of coupled oscillators having a screw axis of symmetry, it is shown that crystals which rotate the plane of polarization can exhibit very large circular dichroism. A. L. MACKAY

535.681 : 621.327.43

5430. The colour-rendering properties of fluorescent lamps and a proposed new method of specification. S. T. HENDERSON AND D. T. WAIGH. *Trans Illum. Engng Soc.*, **18**, *No.* 4, 113–21 (1953).

To express the colour-rendering properties of light sources, a band system of presenting the spectral energy distribution has been used. The best known example of this is Bouma's eight-band system. In this paper Bouma's method of treating the problem is criticized, and the uses and drawbacks of band systems discussed. The next stage of condensation of information on spectral energy distribution leads to single figures of merit to measure colour-rendering properties. Related to this is the present proposal for expressing a single feature of colour-rendering behaviour of fluorescent lamps, namely the red-rendering efficiency, as an index which will distinguish easily between lamps of the "high efficiency" and "high fidelity" types. It

is based on the ratio of energy output at two selected wavelengths, compared with the ratio for a black body or "Planckian radiator" of near or identical colour appearance. Various methods of determining the index are discussed, varying from a calculation based on spectrophotometry to a direct meter measurement. Data are given for a wide selection of lamps. A.

535.7 : 612.84

Physiological optics. *See Abstr.* 5815–23

535.822.9

5431. A new method of light microscopy. R. BARER; A. WILSKA. Letter in *Nature* [*London*] **171,** 697–8 (*April* 18, 1953).

The method of Wilska [Abstr. 3198 (1953)] is said to be a special case of phase-contrast, generally known as amplitude-contrast. The basic theory is explained by a vector treatment and the results are compared with other methods. The second letter replies and makes further comments upon the use of the new method. R. W. FISH

535.89–32

5432. A powerful source for the far ultraviolet without a window. J. ROBIN, S. ROBIN AND B. VODAR. Letter in *J. Phys. Radium,* **13,** 671–2 (*Dec.*, 1952) *In French.*

A water-cooled H_2 discharge lamp is described for use in the region 1000–2000 Å. The lamp has no window and is intended to be used in conjunction with a monochromator. R. W. FISH

HEAT 536

536.21

5433. Application of the Picone procedure to the [solution of the] differential equation of heat conduction. L. VON SZALAY. *Elektrotech. Z.* [*ETZ*] *A,* **74,** 141–3 (*March* 1, 1953) *In German.*

The equation $\nabla^2 u = (1/\alpha)(\partial u/\partial t) - w(r,t)$, where $u = u(r, t)$ is the temperature and r represents the spatial co-ordinates, is difficult to deal with either by conventional methods or by the Laplace transformation when w is not independent of r. It is shown that the use of the Picone procedure [*Monatshefte f. Math.*, **54,** 189 (1950)], which is based on Green's equation, is advantageous, and that then the solution u may be developed in terms of orthogonal eigen-functions. As an example, a rectangular plate containing two point heat sources is considered, and the temperature distribution both in time and space is shown diagrammatically for a particular numerical case. S. WEINTROUB

536.21 : 621.3.017.7

5434. On the heating of a cylinder of finite length with given heat sources. L. VON SZALAY. *Frequenz,* **7,** 81–4 (*March*, 1953) *In German.*

The heating, and cooling after reaching the steady state, of a cylinder, radius r_0 and length $2z_0$, traversed by a constant current I, and with definite quantities of heat produced at the end faces, is treated mathematically. As a numerical example a steel cylinder $2r_0 = 12{\cdot}5$ mm and $2z_0 = 50$ mm, for $I = 5000$ A is considered, and the temperature distribution at various times is shown diagrammatically. S. WEINTROUB (R)

536.24 : 536.7

5435. On the exchange of heat by conduction from one system to another. K. POPOFF. *C.R. Acad. Sci.* [*Paris*] **236,** 785–6 (*Feb.* 23, 1953) *In French.*

Onsager's phenomenological relations have been shown to be the first integrals of the system $(d^2x_i/dt^2) = -(\partial S/\partial \dot{x}_i)$. It is now shown that Fourier's hypothesis regarding heat transport follows from these equations. F. E. HOARE

536.33

5436. On the functional equations of heat radiation in the presence of an absorbing and dispersive medium. YU. A. SURINOV: *Dokl. Akad. Nauk SSSR,* **84,** *No.* 6, 1159–62 (1952) *In Russian.*

Some basic integral equations of the macroscopic kinetics of heat radiation of grey bodies are derived in an elementary way. The bodies are separated by an absorbing and dispersing medium containing heat sources. The derivation is based on the theory of the classification of radiation types considered in earlier papers. MATHEMATICAL REVIEWS

536.42 : 536.7

5437. The thermodynamics of phase changes. I. Heterobaric phase-transitions in one-component systems. G. POROD. *Acta phys. Austriaca,* **6,** *No.* 4, 322–8 (1953) *In German.*

A differential equation analogous to the Clausius–Clapeyron equation is derived for two phases under different pressures. It is shown that it is thermodynamically possible to melt a solid under local pressure below the normal melting point. C. TURNER

536.421.4

5438. The ideal cryometric criterion and the application of Arrhenius' theory. Y. DOUCET. *J. Phys. Radium,* **14,** 81S–82S (*Jan.*, 1953) *In French.*

A short note on an expression of the cryometric law derived from the Clapeyron relations. The slope of the tangent at the origin is not zero as usually implied by Raoult's tonometric law. The case of a salt giving three ions in solution and aqueous solutions of electrolytes are briefly considered. E. H. DOCK

536.423.15

5439. Evaporation of germanium films from a carbon crucible. K. LEHOVEC, J. ROSEN, A. MACDONALD AND J. BRODER. *J. appl. Phys.*, **24,** 513–14 (*May*, 1953).

Equipment for evaporation of germanium in vacuum at various measurable rates is described. The activation energy of evaporation is 3·5 eV, which is in close agreement with recent data by Searcy [Abstr. 3238 (1953)]. A.

536.48

5440. The unsaturated helium film. E. LONG AND L. MEYER. *Advances in Phys.*, **2,** 1–27 (*Jan.*, 1953).

Review article, 36 refs. Chief contents: Adsorption isotherms in the He I and He II region. The He in the first layer is highly compressed. The heat of adsorption and the differential entropy are derived from the isotherms. The latter is $>$ for bulk liquid for $T < T_\lambda$ and $<$ for bulk liquid for $T > T_\lambda$. Direct specific heat measurements on He adsorbed on Fe_2O_3

show no discontinuity at T_λ but a hump which is shifted towards lower temperatures with decreasing saturation. Superfluidity sets in at a definite temperature $< T_\lambda$ which decreases with decreasing saturation, but there is no direct correlation with the specific heat hump. Under certain conditions (low pressure gradient) superflow was observed right up to the λ-point. Heat transport experiments showed again definite "onset" temperatures which agreed with those of the superflow.

H. LONDON

536.48

5441. New and peculiar properties of film transport in helium II. B. N. Esel'son and B. G. Lazarev. *Zh. eksper. teor. Fiz.*, **23**, *No.* 5 (11) 552–63 (1952) *In Russian.*

Conventional film transport experiments were carried out using 5 beakers of different shapes. Series of systematic measurements show that the rate of transfer (volume flow per length unit of brim) decreases with increasing height of the film, which is defined as the distance between the brim and the upper level. Decrease in rate is particularly marked (up to almost 50%) in the initial stage of outflow experiments, starting with zero height. A small decrease towards the end of outflow experiments is accounted for in terms of the mechano-caloric effect. At equal height another difference in rate is found if first outflow, subsequent inflow and repeated outflow are compared. The authors summarize results by saying that the high rate of transfer at small heights has a retarding effect on the flow to follow.

R. EISENSCHITZ

536.48

5442. Helium II film transport rates over various surfaces. B. Smith and H. A. Boorse. Letter in *Phys. Rev.*, **90**, 156–7 (*April* 1, 1953).

Reports transport rates over lucite, machined nickel, pyrex, quartz and machined thorium, as determined by the capacitor depth gauge method.

R. B. DINGLE

536.48

5443. Hydrodynamics of solutions of extraneous particles in helium II. I. M. Khalatnikov. *Zh. eksper. teor. Fiz.*, **23**, *No.* 2 (8) 169–81 (1952) *In Russian.*

The hydrodynamical equations of pure liquid helium II are derived, first by setting out from the appropriate conservation laws, and secondly by a variational method; the equations as derived by the second method are formally valid for any values of the normal and superfluid velocities. The first derivation is extended to cover the behaviour of solutions of extraneous particles in helium II and it is shown that such particles take part only in the "normal" motion of the liquid, provided the pure dissolved substance has not itself the property of superfluidity.

D. SHOENBERG

536.48

5444. Sound in solutions of extraneous particles in helium II and the dissipative function of solutions. I. M. Khalatnikov. *Zh. eksper. teor. Fiz.*, **23**, *No.* 3 (9) 265–74 (1952) *In Russian.*

The hydrodynamic equations for concentrated solutions in helium II (preceding abstract) are applied to the propagation of sound; general expressions are derived for the velocities of first and second sound in such solutions and the form of the dissipative function is obtained. It is shown that besides the kinetic coefficients necessary to describe the behaviour of pure helium II two further coefficients—of diffusion and of thermal diffusion—have to be introduced.

D. SHOENBERG

536.48

5445. Shock waves and sound of large amplitude in helium II. I. M. Khalatnikov. *Zh. eksper. teor. Fiz.*, **23**, *No.* 3 (9) 253–64 (1952) *In Russian.*

The conditions are formulated for the propagation of discontinuities (i.e. shock waves) in helium II and a previous discussion by Temperley [Abstr. 2633 (1951)] is criticized. It is shown that in a superfluid liquid two types of discontinuities, one of pressure and one of temperature (i.e. shock waves in first and second sound respectively) may be propagated. The velocities of propagation for low intensity shock waves are calculated and the theory is found to agree with experiments on second sound by Osborne [Abstr. 2631 (1951)]. The propagation of sound of large amplitude both in pure helium II and in solutions of extraneous particles in helium II are also discussed.

D. SHOENBERG

536.631

5446. Specific heat of diamond at low temperatures. W. De Sorbo. *J. chem. Phys.*, **21**, 876–80 (*May*, 1953).

Specific heat data on diamond at temperatures between 20° and 300°K are reported. Comparisons of the data have been made with the predictions of the Debye theory. The deviation of the specific heat from the value given by the three-dimensional continuum theory in the low temperature region can be qualitatively described in terms of a superposition of a simple Einstein frequency. It has been found that variations that occur in expressing reduced characteristic temperatures as a function of reduced temperatures for diamond are qualitatively similar to those of the face-centred cubic metals Al, Cu and Ag. The values of entropy, enthalpy and free energy have been determined and tabulated at integral values of temperature from 25° to 300°K. The entropy of diamond at 298·16°K is 0·568 ± 0·005 cal/g.atom.deg.

THERMODYNAMICS 536.7/.8

536.7

5447. Coefficient of fugacity of saturated vapours. Case of water and ammonia. J. Broch. *J. Phys. Radium*, **14**, 134–5 (*Feb.*, 1953) *In French.*

If the equation of state may be written $pv = RT + ap + bp^2 + \ldots$ then $RT \ln \chi = ap + (b/2)p^2 \ldots$, where χ is the ratio of fugacity and pressure. The experimental results for saturated water vapour and ammonia are considered and it is shown that there is a linear relation between $\log \ln (1/\chi_s)$ and $\log p$ to a close approximation.

F. E. HOARE

536.7 : 532.77

5448. Application of the cell method to the statistical thermodynamics of solutions. II. Experimental. V. MATHOT AND A. DESMYTER. *J. chem. Phys.*, **21**, 782–8 (*May*, 1953).

In connection with the theory of solutions proposed by Prigogine and Mathot [Abstr. 2686 (1952)], total vapour pressures and volume changes on mixing have been measured for the systems: CCl_4 — $C(Me)_4$ (I), C_6H_{12}— $C(Me)_4$ (II), C_6H_6 — $C(Me)_4$ (III). Volume changes only for the systems: $CCl(Me)_3$ — CCl_4 (IV), $CCl_2(Me)_2$ — CCl_4 (V), $CCl_3(Me)$ — CCl_4 (VI), $C(Me)_3OH$ — CCl_4 (VII). For I, II and III, one observes a positive excess free energy (positive deviations to the Raoult law) together with a negative excess volume (contraction on mixing), whereas for IV, V, VI and VII there is a gradual passage from negative (IV) to positive (VII) excess volume. These results are discussed in terms of the molecular interactions *AA*, *BB* and *AB*. Reasonable agreement is observed between experiment and Prigogine and Mathot's theory. A.

536.75

5449. Methods of plotting entropy charts for the equilibrium phases of the water-ammonia solution. L. M. ROZENFEL'D. *Dokl. Akad. Nauk SSSR*, **82**, *No.* 5, 723–5 (1952) *In Russian.*

Equations are developed for the differential isobaric liquid-phase potential of NH_3, the isobaric thermodynamical potential of the NH_3 vapour phase, the equation of equilibrium concentrations for the liquid phase of the solution, and the concentration of the vapour phase. The author has plotted 2 new charts for the equilibrium phases of the H_2O–NH_3 solution: temperature-entropy and enthalpy-entropy.

F. LACHMAN

ELECTRICITY 537

THEORY . ELECTRONS 537.1

537.12

5450. On the new formulation of electrodynamics by Dirac. A. KOMPANEETS. *Dokl. Akad. Nauk SSSR*, **82**, *No.* 6, 873–5 (1952) *In Russian.*

Dirac showed that for the limiting case of small λ his equations go over into equations of motion of a small charge in the magnetic field. The solution for a charged sphere is twofold: (i) the charges diverge; for low initial density the solution agrees with the usual one; (ii) the charges converge to the centre, not corresponding to physical reality. J. JACOBS

ELECTROSTATICS . DIELECTRICS 537.2

537.221

5451. On the calculation of contact potential differences. H. DORMONT. *C.R. Acad. Sci.* [*Paris*] **236**, 1009–11 (*March* 9, 1953) *In French.*

Starting from the Fermi–Dirac energy distribution it is shown that the c.p.d. precisely equals the difference between the work functions measured at the temperature of operation, and that the expression with the extra term $kT \log A_1/A_2$ is incorrect. A. H. W. BECK

537.221

5452. On contact phenomena. H. DORMONT. *C.R. Acad. Sci.* [*Paris*] **236**, 1238–40 (*March* 23, 1953) *In French.*

It is shown that when the work function and barrier transparency depend slightly on temperature [ϕ, A of the form ϕ_0, $A_0(1 + aT)$] the c.p.d. is given by $\gamma' - \gamma + kT(\log c/c' - \log D_0/D_0')$ where the γ's are the work functions measured at absolute zero, the D_0's are the barrier transparencies and the c's are $A_0e^{-a/k}$ for the two materials. A. H. W. BECK

537.226.1

5453. On polarization in liquid dielectrics. G. JAFFÉ AND C. Z. LEMAY. *J. chem. Phys.*, **21**, 920–8 (*May*, 1953).

A theory of polarization originally developed for crystals is extended in such a way as to be applicable to d.c. measurements in liquid dielectrics. The general time-dependent solution of the relevant differential equation is obtained by the method of eigenvalues. It leads to expressions for the "charging current" and the "discharge current," which are characteristic of liquids. The measurements and their results are next described. They refer to solutions in hexane, and to pure hexane rendered conductive by radium radiation. Attempts to obtain photoconductivity were futile. It is shown that the observations can be correlated by the theory provided the presence of two species of ions of different mobilities is assumed. A few cases of quantitative analysis are carried out. They lead to the determination of the mobility of the slower ions, and of the thickness of the polarization layers. Some aspects of polarization in crystals are discussed in the light of the more recent development. A.

537.226.2

5454. Metastable states of $BaTiO_3$. N. V. NOVOSIL'TSEV, A. L. KHODAKOV AND M. S. SHUL'MAN. *Dokl. Akad. Nauk SSSR*, **83**, *No.* 6, 829–31 (1952) *In Russian.*

Single and polycrystals of $BaTiO_3$ and a solid solution of $BaTiO_3$ in $SrTiO_3$ show a reversible fall of electrical properties (dielectric capacity and loss angle) after heating. Daylight and, more effectively, cathode bombardment cause a darkening of $BaTiO_3$ which can be eliminated by heating. There is no change in the crystal parameters or weight of the samples during this aging. R. C. MURRAY

537.226.2

5455. The character of the higher transition in $BaTiO_3$. W. HEYWANG. *Entwicklungsber. Siemens & Halske*, **15**, 87–90 (*May*, 1952) *In German.*

Both the continuance of hysteresis near the upper transition point and also the field and pressure dependence of the hysteresis in single-domain crystals of $BaTiO_3$ can be explained only by the postulation of a first-order transformation. Yet nevertheless, especially in polycrystalline material, oscillation phenomena can so obscure the small latent heat that a decision on the order of the transition is impossible.

A. L. MACKAY

537.226.2

5456. Theory of the dielectric properties of barium titanate in stationary fields. A. E. GLAUBERMAN AND A. F. LUBCHENKO. *Zh. eksper. teor. Fiz.*, **23**, *No.* 2 (8) 188–98 (1952) *In Russian.*

An approximate calculation is made of the actual field in $BaTiO_3$ and of the susceptibility below the Curie point (T_c), on the basis of the existence of a covalent bond between the Ti ion and one of the O ions when calculating the geometrical structure of the lattice. The qualitative theory gives the dependence of ε on temperature for $T < T_c$ and a value of T_c. A general method of calculating the dependence of ε on external field, and the dependence of the spontaneous polarization on T, is outlined. A. L. MACKAY

537.226.2

5457. The influence of departures from stoichiometric composition on the properties of $BaTiO_3$ ceramic in strong fields. N. S. NOVOSIL'TSEV, A. L. KHODAKOV AND M. S. SHUL'MAN. *Zh. eksper. teor. Fiz.*, **23**, *No.* 3 (9) 336–9 (1952) *In Russian.*

Polycrystalline $BaTiO_3$ with BaO/TiO_2 ratios within the range 0·940 to 1·024 had widely varying dielectric properties. At 0·970, ε near 125° was doubled and at 1·024 reduced by 30%. In strong fields the increase of ε with TiO_2 content was most marked for fields of about 5 kV/cm. A. L. MACKAY

537.226.2

5458. Dielectric constants of isomorphous [specimens of] ammonium phosphate and arsenate. C. DELAIN. Letter in *J. Phys. Radium*, **14**, 64 (*Jan.*, 1953) *In French.*

Data are given for pure $NH_4H_2PO_4$ and $NH_4H_2AsO_4$ and for mixtures of the two for the temperature range −100°C to +100°C. C. A. HOGARTH

537.226.2

5459. The dielectric permittivity of solid hydrobromic acid at 10 000 Mc/s. L. LAGERDA AND C. BROT. *C.R. Acad. Sci.* [*Paris*] **236**, 916–18 (*March* 2, 1953) *In French.*

537.226.2 : 621.317.335.3

5460. A method of measuring the complex dielectric constant and permeability in the hyperfrequency region. A. SURDUTS. *C.R. Acad. Sci.* [*Paris*] **236**, 900–2 (*March* 2, 1953) *In French.*

ε', ε'', μ' and μ'' are obtained from the standing wave patterns in the waveguide in front of a slab of material which is followed firstly by a short circuit and secondly by a lossy wedge matched impedance. D. H. WHIFFEN

537.226.2 : 621.317.335.3 : 621.317.374

5461. On the question of the measurement of the dielectric loss angle and permittivity of solid dielectrics in the regions of ultra-short and decimeter waves. K. A. VODOP'YANOV AND B. I. VOROZHTSOV. *Zh. tekh. Fiz.*, **22**, *No.* 11, 1877–80 (1952) *In Russian.*

The assumptions and approximations in the formulae of various Russian authors for determining ε and $\tan\delta$ from measurements with dielectric disks perpendicular to parallel wires are discussed. By comparison with experiment the formulae of Kessenikh and Vodop'yanov [*Zh. eksper. teor. Fiz.*, **2**, 273 (1932)] is preferred. D. H. WHIFFEN (R)

537.226.3

5462. Temperature-frequency dependence of the angle of dielectric loss in crystals with polar molecules. K. A. VODOP'YANOV. *Dokl. Akad. Nauk SSSR*, **84**, *No.* 5, 919–21 (1952) *In Russian.*

Curves of $\tan\delta$ and ε up to 10^8 c/s are given. At 293°K there are peaks in $\tan\delta$ at 8×10^4 c/s for phlogopite mica; 2×10^7 for crystalline gypsum with weaker peak at 3×10^6 c/s with activation energies of 0·59 and $1{\cdot}62\times10^{13}$ erg respectively; at 10^7 and 2×10^6 c/s for crystalline talc. There is no loss in a crystal of rock salt. D. H. WHIFFEN

537.226.3 : 621.315.614.4

5463. A dissipation factor anomaly. R. M. BELL AND H. HILL. Note in *Amer. J. Phys.*, **21**, 389 (*May*, 1953).

Measurements at 1 kc/s on natural cork containing 0–12% water show a monotonic increase of dielectric constant but a maximum of 1·2 in the dielectric loss factor at 7% water content. F. F. ROBERTS

537.226.3–14 : 621.317.335.3

5464. A new method of measurement of the complex dielectric constant of solids and liquids at centimetre wavelengths. Results of measurement of dielectric constants at 9500 Mc/s by a new method. J. LE BOT AND S. LE MONTAGNER. *C.R. Acad. Sci.* [*Paris*] **236**, 469–71 (*Feb.* 2); 593–4 (*Feb.* 9, 1953).

The sample in the form of a thin cylinder, or liquid in a glass tube, is placed centrally and perpendicular to the large dimension of a rectangular waveguide. The measurements require a movable reflector behind and a fixed detector in front of the sample. The calculations are outlined. Results at 9500 Mc/s agree with literature values. D. H. WHIFFEN

537.228.1 : 548.0

5465. Polar crystal form and piezoelectricity of ice. S. STEINEMANN. *Experientia*, **9**, *No.* 4, 135–6 (1953) *In German.*

Piezoelectricity of ice was investigated by two methods whose sensitivity was determined separately. No effect has been found. An electromechanical coupling of 10^{-3} or a corresponding piezoelectric modulus of $1{\cdot}5\times10^{-9}$ (stat. clbs. dyn^{-1}) would have been the lower limit for detecting piezoelectricity. Special attention was given to the selection of homogeneous crystals for these tests. A.

ELECTRIC CONDUCTION . CURRENTS 537.3

537.311.1 : 537.311.62

5466. The differential law of the intensity of electric fluctuations and the influence of the skin effect on them. M. A. LEONTOVICH AND S. M. RYTOV. *Zh. eksper. teor. Fiz.*, **23**, *No.* 3 (9) 246–52 (1952) *In Russian.*

The form of the correlation function of the extraneous electric field responsible for the integral e.m.f. of the thermal electrical fluctuations, the spectral intensity of which is represented by the Nyquist formula, is found for quasi-steady conditions. For the frequency ω corresponding to such conditions, the authors obtain an expression of the integral e.m.f.

set up by an extraneous field arbitrarily distributed over the volume of the conductor. It is shown that, for proportionality to exist between the spectral intensity of the integral e.m.f. of random distribution and the active resistance of the conductor, it is sufficient to assume the correlation radius α of the extraneous field $\ll$ conductor radius a and thickness of the skin layer d. B. F. KRAUS

537.311.33

5467. On the temperature dependence of the mobility of charge carriers in semiconductors. E. D. DEVYATKOVA, YU. P. MASLAKOVETS, L. S. STIL'BANS AND T. S. STAVITSKAYA. *Dokl. Akad. Nauk SSSR*, **84**, *No.* 4, 681–2 (1952) *In Russian.*

For materials of atomic lattice the mobility $\mu = AT^{-3/2}$, while for materials of ionic lattice $\mu = AT^{-1/2}$, where A is a constant not depending on temperature. While investigating the temperature dependence of electrical conductivity and Hall constant, the authors found that in PbSe the mobility followed the new law $\mu = AT^{-3}$. Measurements were over temperature limits 20–500°C which range is supposed to be above the Debye temperature (~ -50°C). Such a new law demands a radical revision of the theory of electron interaction with the thermal vibrations of the lattice and the mean free path of the charge carriers should be related to energy (cf. Wiedemann–Franz law). There are deviations from the new law at low temperatures. W. BARDSLEY

537.311.33

5468. A study of the properties of boron. J. LAGRENAUDIE. *J. Phys. Radium*, **14**, 14–18 (*Jan.*, 1953) *In French.*

According to measurements up to 700°C boron has an activation energy for intrinsic conduction of 1·28 eV. Thin films are opaque to visible light but transparent in the infrared beyond 1 μ. The boron used possessed only insignificant rectifying properties. H. P. MYERS

537.311.33

5469. Electronic conduction in silicon carbide. J. T. KENDALL. *J. chem. Phys.*, **21**, 821–7 (*May*, 1953).

Pure silicon carbide was prepared by decomposition of the vapours of silicon tetrachloride and toluene on a hot carbon filament. Various *n*- and *p*-type impurity atoms were introduced by the addition of volatile metallic chlorides during the preparation. For the pure substance either *n*- or *p*-type crystals could be obtained by varying the ratio of the reaction constituents. The results show that semiconductivity in silicon carbide may be due either to non-stoichiometric proportions of silicon and carbon, or to the presence of impurity atoms, or (as probably occurs in the commerical product) to both circumstances simultaneously. A theoretical model for electronic conduction in silicon carbide is proposed, which satisfactorily explains the magnitude of the low and high temperature activation energies observed, their different ratios in *n*- and *p*-type crystals, the occurrence of conduction at one of the disturbance energy levels and the anomalous low Hall constant at low temperatures found in black but not in green silicon carbide. The model may be applicable to other semiconductors in which disturbance centres can give rise to electrons in unlocalized excited states. A.

537.311.33

5470. Note on the nature of conduction in liquid iron oxide and iron silicates. M. T. SIMNAD AND G. DERGE. *J. chem. Phys.*, **21**, 933–4 (*May*, 1953).

Current efficiency has been measured for the entire range of melts between iron oxide and the silica-saturated slag. All compositions show some ionic conductivity, but the proportion of this type of conductance increases with the concentration of silica. A.

537.311.37 : 539.893

5471. Electrical conductivity of gases at high temperatures and densities. A. S. KARPENKO, A. M. MARKEVICH AND YU. N. RYABININ. *Zh. eksper. teor. Fiz.*, **23**, *No.* 4 (10) 468–76 (1952) *In Russian.*

Measurements have been carried out in the apparatus described in Abstr. 5741 (1953). The electrical conductivity of air has been determined for pressures 900–9000, that of commercial N for pressures 1800–6300, and that of commercial A for pressures 300–5600 kg/cm^2. Conductivity of adiabatically compressed air is of ohmic nature. Variations of conductivity observed for compressed air and A depend on pressure variations. Comparison of experimental data with theory shows that the main cause of electrical conductivity of air and N in the conditions of the experiment is the ionization of NO formed as a result of chemical reaction. F. LACHMAN

537.312.5

5472. Photo-e.m.f.'s in a semiconductor possessing single-sign photoconductivity. K. B. TOLPYGO. *Zh. eksper. teor. Fiz.*, **23**, *No.* 3 (9) 340–8 (1952) *In Russian.*

The kinetic equations describing the production of a photo-e.m.f. in a semiconductor irradiated with sinusoidally modulated light are derived and solved in a linear approximation. It is assumed that the values of the dark and light conductivity are equal. The cases of an insulated semiconductor and of a semiconductor with deposited electrodes are considered on the assumption that in the dark the electric field inside the semiconductor is zero. The formulae obtained may be used for estimating the concentration of the surface levels and the life of the electrons populating them and, correspondingly, for estimating the transparency of the gap between the semiconductor and the metal electrode. B. F. KRAUS

537.312.5

5473. Internal photoelectric effect in polycrystalline cadmium sulphide. B. T. KOLOMIETS. *Dokl. Akad. Nauk SSSR*, **83**, *No.* 4, 561–3 (1952) *In Russian.*

It has been found that partial high-temperature oxidation of CdS crystalline powder can change the ohmic resistance of specimens within wide limits (10^{12}–10^2 ohms). The specimens obtained by this treatment display a considerable photoconductivity with a sharp peak near 5000 Å, the two arms of the curve being less steep than for a CdS single crystal but more so than for powder consisting of tiny single crystals. It has been found that partial oxidation does not affect the photoconductivity mechanism. F. LACHMAN

537.312.62

5474. Behaviour of superconducting films in a magnetic field. V. L. GINZBURG. *Dokl. Akad. Nauk SSSR*, **83**, *No.* 3, 385–8 (1952) *In Russian.*

The magnetic behaviour of thin superconducting films is discussed in terms of the theory of Ginzburg and Landau [Abstr. 1017 (1952)]: it is shown that if the thickness is less than $1{\cdot}12\lambda$ (λ = penetration depth) the transition in a magnetic field is of the 2nd order, and the critical field is given by $\sqrt{(6)}H_c\lambda/d$, where H_c is the bulk critical field. For $d > 1{\cdot}12\lambda$ the transition is 1st order. The form of the magnetization curve is also calculated. The values of λ deduced by comparing the limiting formulae for critical field for thick and thin films with appropriate data by Lock [Abstr. 7909 (1951)] and Zavaritskiĭ [Abstr. 1018 (1952)] are not very consistent. D. SHOENBERG

537.312.62

5475. Influence of size on the critical field of superconductors of the second group. A. A. ABRIKOSOV. *Dokl. Akad. Nauk SSSR*, **86**, *No.* 3, 489–92 (1952) *In Russian.*

The phenomenological theory of Ginzburg and Landau [Abstr. 1017 (1952)] contains a dimensionless parameter $\kappa = \sqrt{2}(e/\hbar c)H_c\lambda^2$ (H_c = bulk critical field, λ = penetration depth into bulk specimen). The theory of the critical field of thin films had previously been worked out only for $\kappa < 1/\sqrt{2}$ (superconductors of "the first group") and is now extended to cover $\kappa > 1/\sqrt{2}$ (superconductors of "the second group"). It is suggested that thin tin and thallium films deposited at low temperatures may be superconductors of the second group and some support for the theory is found in measurements on such films by Zavaritskiĭ (abstract following).

D. SHOENBERG

537.312.62

5476. Investigation of superconducting properties of thallium and tin films deposited at low temperatures. N. V. ZAVARITSKIĬ. *Dokl. Akad. Nauk SSSR*, **86**, *No.* 3, 501–4 (1952) *In Russian.*

Measurements were made of (*a*) the critical magnetic field, (*b*) the magnetization curve in a longitudinal field, for thin films (2×10^{-6} cm to several microns) of tin and thallium deposited on glass at 2°K and 80°K in rigorous high vacuum conditions. As found previously the films deposited at 2°K had much higher critical fields than those annealed at 300°K or deposited at 80°K. Although the restoration of resistance took place fairly sharply in both unannealed and annealed films, the magnetic moment measurements showed that in the former, field penetration took place over a wide range of fields and it is suggested that the transition is really a second order one (as in Abrikosov's "second group of superconductors," preceding abstract). D. SHOENBERG

537.312.62

5477. Surface resistance of superconducting tin at 9400 Mc/s. M. S. KHAĬKIN. *Dokl. Akad. Nauk SSSR*, **86**, *No.* 3, 517–20 (1952) *In Russian.*

Measurements were made both of the breadth of resonance and the displacement of resonant frequency of resonators containing (*a*) bulk superconducting tin and (*b*) thin superconducting tin films (4 to 12×10^{-6} cm thick). Accuracy of measurements was of order 10%. The data (which for bulk tin agree with those of Pippard, 1950) are interpreted in terms of Ginzburg's theory of high frequency absorption [Abstr. 5125 (1952)]. D. SHOENBERG

537.312.62

5478. On the question of the superconductivity of bismuth. N. V. ZAVARITSKIĬ. *Dokl. Akad. Nauk SSSR*, **86**, *No.* 4, 687–90 (1952) *In Russian.*

The discovery by Hilsch of superconductivity in thin films of Bi deposited on glass at helium temperatures was confirmed; T_c was found to be about $5{\cdot}8$°K. Similarly prepared films of Ag, Cu, Mg and Sb did not become superconducting. If the Bi film is warmed above about 20°K a modification sets in and the film is then no longer superconducting at lower temperatures; this was shown to be associated with a colour change and the curve at $4{\cdot}2$°K of optical transmission coefficient against wavelength which is flat for the superconducting modification shows a sharp dip above 5000 Å for the non-superconducting modification (for a film annealed at 45°K). D. SHOENBERG

537.312.62

5479. Structure of superconductors in the intermediate state. YU. V. SHARVIN AND B. M. BALASHOVA. *Zh. eksper. teor. Fiz.*, **23**, *No.* 2 (8) 222–8 (1952) *In Russian.*

Using the method devised by Shalnikov [*Zh. tekh. Fiz.*, **9**, 202 (1945)] in which a long bismuth wire is used to reveal inhomogeneities of magnetic field (based on the non-linearity of the relation between resistance and field), the homogeneity of field in a narrow gap between two monocrystalline tin hemispheres in the intermediate state was studied. Contrary to observations based on a micro-probe technique [Meshkovskii and Shalnikov, *Izv. Akad. Nauk SSSR Ser fiz.*, **11**, 39 (1947)] the inhomogeneity found (due to the fine structure of the intermediate state) did not appear to depend on the particular order of variation of field and temperature by which the state concerned was reached. It is suggested that this discrepancy may arise from the technique, which averages the detailed inhomogeneity structure, or may be due to some difference in quality of specimens. D. SHOENBERG

537.312.62

5480. Introduction of anisotropy into the theory of superconductivity. V. L. GINZBURG. Letter in *Zh. eksper. teor. Fiz.*, **23**, *No.* 2 (8) 236–8 (1952) *In Russian.*

The Ginzburg and Landau theory [Abstr. 1017 (1952)] is modified to take account of possible anisotropy. D. SHOENBERG

537.312.62

5481. Superconductivity of alloys of the system Bi–Pd. N. E. ALEKSEEVSKIĬ. Letter in *Zh. eksper. teor. Fiz.*, **23**, *No.* 4 (10) 484 (1952) *In Russian.*

BiPd and $BiPd_2$ were found to become superconducting at roughly $3{\cdot}7$°K and $4{\cdot}0$°K respectively; the transition of $BiPd_2$ was very spread out, and it is not yet certain that the superconductivity may not have been due to an alloy of some other Pd-rich composition. The transition temperature of Bi_2Pd [Abstr.

3600 (1952)] was found to decrease under hydrostatic pressure. D. SHOENBERG

537.312.62

5482. Superconducting compounds of nonsuperconducting elements. B. T. MATTHIAS. Letter in *Phys. Rev.*, **90**, 487 (*May* 1, 1953).

The following compounds become superconducting at the temperatures given in brackets: PdSb (~1·5°K), PtSb (~2·1°K), PtBi (~1·21°K), PdTe (~2·3°K), IrGe (~4·7°K). H. LONDON

537.312.62 : 537.226.2

5483. Determination of the value of the dielectric constant and normal conductivity of superconductors. A. A. ABRIKOSOV. *Dokl. Akad. Nauk SSSR*, **86**, *No.* 1, 43–6 (1952) *In Russian.*

General formulae are given which enable the conductivity σ of the "normal" electrons and the effective dielectric constant ε to be deduced from measurements of the surface impedance of a superconductor in a high frequency field. The calculations are based on the theory of Reuter and Sondheimer [Abstr. 1032 (1949)]. It is pointed out that the surface impedance of a thin film involves σ and ε in a simpler way than for bulk metal, so that measurements on thin films might provide a more reliable determination of σ and ε. D. SHOENBERG

537.32

5484. Measurement of thermoelectric power for very small differences of temperature. J. SAVORNIN AND F. SAVORNIN. *C.R. Acad. Sci.* [*Paris*] **236**, 898–900 (*March* 2, 1953) *In French.*

Measurements of the thermoelectric power at 15°c of *p*-type Si carried out for very small differences of temperature show that the value obtained is independent of temperature difference. Careful measuring techniques enabled differences as low as 0·01° to be maintained. C. A. HOGARTH

537.365 : 534.39 : 541.13

Electrokinetic effects produced by ultrasonic waves. *See Abstr.* 5747–5750

ELECTRIC DISCHARGES 537.52

537.523.4 : 537.525.4

5485. Transient discharges in a mercury arc. G. RAOULT AND A. LALANDE. *C.R. Acad. Sci.* [*Paris*] **236**, 1242–4 (*March* 23, 1953) *In French.*

Briefly describes expts. on the excitation of ionized mercury (Hg II, Hg III and Hg IV) by the discharge, through an arc, of high voltage capacitors up to 20 μF in size. J. D. CRAGGS

537.523.4 : 621.316.5.064

5486. Sparking potentials between separating contacts. C. W. KLEE AND H. S. STAUSS. Letter in *J. appl. Phys.*, **24**, 368–9 (*March*, 1953).

Relates the breakdown voltage to contact separations for dynamic (moving contacts) and static (stationary contacts) conditions and shows that the characteristics (breakdown voltage—gap length) are very similar for both conditions. Discharge parameters were: d.c. 0·6 A, 150 Ω, 9 H, in series with the contacts, 6×10^{-8} F shunt capacitance; the contacts were crossed iron cylinders, $\frac{3}{16}$ in. in dia. operating in open air. J. D. CRAGGS

537.523.4 : 621.319.5

5487. A generator for 100 kV condensed discharges. F. VALENTIN AND M. SAGOT. *J. Phys. Radium*, **14**, 80–1 (*Jan.*, 1953) *In French.*

Briefly describes an impulse generator circuit for excitation of spark discharges in gases, and representative spectra are given. J. D. CRAGGS

537.523.5

5488. The temperature and electron density in a water-stabilized arc. G. JÜRGENS. *Z. Phys.*, **134**, *No.* 1, 21–41 (1952) *In German.*

Describes measurements of absolute intensities of Balmer lines, electron densities from the first-order, inhomogeneous-field Stark effect, and electron temperatures from the measurement of Balmer continuum intensities in a hydrogen-oxygen arc of the water turbine type described by Maecker and others. The results obtained with these different techniques agree well and for the particular arcs in question only varied from 12 500 ± 600°K to 13 300 ± 750°K. J. D. CRAGGS

537.523.5 : 621.3.014.31

5489. The electric arc in argon and helium. T. B. JONES, M. SKOLNIK AND W. B. KOUWENHOVEN. *Applic. and Industr.*, *No.* 5, 16–21 (*March*, 1953).

Gives voltage-current and voltage-gap length characteristics for arcs in argon between tungsten electrodes (10–100 A) at 1 atmos. pressure. A voltage-current curve is also given for helium. The appearance and stability of the arcs are described. J. D. CRAGGS

537.523.74

5490. Conditions for natural oscillations and movement of layers in a [gas] discharge. A. A. ZAĬTSEV. *Dokl. Akad. Nauk SSSR*, **84**, *No.* 1, 41–4 (1952) *In Russian.*

These were investigated in neon-filled tubes with cold electrodes across which a variable potential could be superimposed upon a normal constant one. Two kinds of natural oscillations (no external imposed variable potential) are distinguished: "Hard," accompanied by a sudden increase in the average current passed by the tube, a change in the anode p.d. with the potential gradient down the positive column unchanged, and hysteresis, and "soft," characteristic of the cathodic parts of the discharge, and setting in gradually from quite small amplitudes. Natural oscillations can be "synchronized" to forced oscillations if the difference of frequency between them, $\Delta\nu$ is small; here quasi-stationary gas layers are formed. If $\Delta\nu$ is somewhat larger, beats are formed and there is a movement of the gas layer at the beat frequency. Various subsidiary phenomena are described but no attempt is made to account for any of them. R. C. MURRAY

537.525.4 : 537.525.8

5491. The breakdown voltages of gaseous discharges in transverse magnetic fields, for the pressure range 10 to 10^{-8} mm Hg. R. HAEFER. *Acta phys. Austriaca*, **7**, *No.* 1, 52–90 (1953) *In German.*

Gives a very detailed experimental and theoretical account of breakdown voltage measurements for

discharges in (essentially) coaxial cylinder tubes with axial magnetic fields. The electrode arrangement is similar to that previously studied by Wehrli and, more recently and thoroughly, by Penning. Experimental data for various gases are shown and a detailed theoretical treatment of breakdown mechanisms, which involves a study of the motion of the ionizing electrons in the magnetic field, is given.

J. D. CRAGGS

537.525.4 : 537.525.8

5492. Quenching of afterglow in gaseous discharge plasmas by low power microwaves. L. GOLDSTEIN, J. M. ANDERSON AND G. L. CLARK. Letter in *Phys. Rev.*, **90**, 486 (*May* 1, 1953).

Describes expts. on afterglows following 1 or 2 μsec d.c. pulse discharges in the rare gases at pressures ranging from 0·1 to 20 mm Hg. By transmitting u.h.f. radiation at one, or at two frequencies simultaneously, through the decaying plasma, it is possible to obtain a cross-modulation effect (using two frequencies) or to demonstrate the finite relaxation time (electron swarm—atom swarm) following a momentary increase in electron temperature due to absorption of a stream of radiation (using a single frequency).

J. D. CRAGGS

537.529

5493. Concerning dielectrics of high electric strength. E. K. ZAVADOVSKAYA. *Dokl. Akad. Nauk SSSR*, **82**, *No.* 3, 709–12 (1952) *In Russian.*

Using a previously published relationship [Abstr. 5819 (1952)] the electric strength is calculated from the lattice energy for a number of substances with crystals of the type of rock salt; experimental values are also given and good agreement is claimed. Fluorides, sulphides and carbides are usually of high electric strength, but reasons are suggested why some of them are not.

W. R. STOKER

537.529

5494. The dependence of electrical strength on crystallographic direction. A. A. VOROB'EV. *Dokl. Akad. Nauk SSSR*, **86**, *No.* 4, 681–2 (1952) *In Russian.*

Impulses were applied to specimens of rock salt immersed in oil and were increased in voltage until breakdown took place. Tests were made about 75 times in each of three main directions giving, for the 0·5 mm thickness of dielectric, strengths of $E_{100} = 1{\cdot}33$, $E_{110} = 1{\cdot}29$ and $E_{111} = 1{\cdot}22$ MV/cm. The anisotropy is not thought to be significant.

A. L. MACKAY

X-RAYS 537.531

537.531 : 535.33/.34

5495. Some results of X-ray spectroscopy: from the colour of silver to the electron structure of the "actinades." Y. CAUCHOIS. *J. Phys. Radium*, **14**, 73S–75S (*Jan.*, 1953) *In French.*

A brief discussion of the way in which, by yielding information on the distribution of energy states in metals, X-ray spectroscopy can aid the solution of certain problems. The position of the absorption band in the near u.v. in silver can be determined from the X-ray emission spectrum, and discontinuities in the absorption spectrum of thorium support the theory of mixed *d* and *f* states in the "actinides."

A. E. DE BARR

537.531 : 535.33/.34

5496. Emission and absorption *L*-spectra of holmium (67). P. SAKELLARIDIS. *C.R. Acad. Sci.* [*Paris*] **236**, 1014–16 (*March* 9, 1953) *In French.*

Numerical data are given for three absorption edges, each with several associated maxima and minima of absorption, and for emission lines.

A. R. STOKES

537.531 : 535.33/.34

5497. Emission and absorption *L*-spectra of gadolinium (64) and thulium (69). P. SAKELLARIDIS. *C.R. Acad. Sci.* [*Paris*] **236**, 1244–6 (*March* 23, 1953) *In French.*

See preceding abstract. Similar data are given.

A. R. STOKES

537.531 : 535.33/.34

5498. *L* emission and absorption spectra of europium (63) and terbium (65). P. SAKELLARIDIS. *C.R. Acad. Sci.* [*Paris*] **236**, 1547–9 (*April* 20, 1953) *In French.*

Further results from a series of measurements on rare-earth elements (see preceding abstracts).

J. J. WILKINS

537.531 : 535.33/.34

5499. Energy levels and weak emissions of the elements: Tm (69), Ho (67), Tb (65), Gd (64), Eu (63). P. SAKELLARIDIS. *C.R. Acad. Sci.* [*Paris*] **236**, 1767–9 (*May* 4, 1953) *In French.*

Electronic energy levels, deduced from measurements of *L* spectra (preceding abstracts), are tabulated. Some observations on weak emitted rays are also reported.

J. J. WILKINS

537.531 : 535.33

5500. The breadth of spectral lines and hyperfine structure in X-ray spectra. D. CURIE. *J. Phys. Radium*, **13**, 505–15 (*Nov.*, 1952) *In French.*

Conventional perturbation theory of the natural width of spectral lines predicts an anomalous broadening of the K_{α_1} and K_{α_2} lines of high nuclear magnetic moment and spin. The theory assumes that the probability of finding the excited atom in the sub-level $K_i (i = 1,2)$ decreases exponentially, i.e. $b_{Ki0} = (1/\sqrt{2})e^{-\gamma_i t}$ where γ_i is a constant such that the line breadths equals γ_i/π and the transition probability $P_i = 2\gamma_i (i = 1,2)$. The predicted anomalies, although, in principle, capable of experimental verification (e.g. for niobium in the range Rb to Sn) are not in fact observed. A more general formulation is therefore proposed in which γ_i' is now assumed to be a function of the time. Perturbation theory then gives a system of integro-differential equations which by use of the properties of the δ function may be reduced to a system of simple differential equations. These contain the transition probabilities P_i (for γ constant) as parameters and a third parameter P_{12} proportional to the product of the matrix elements of interaction Hamiltonian for the two possible transitions. If $P_{12} = 0$ the values of γ_i' may be deduced as being equal to the values obtained for γ_i (constant). A non-zero value of P_{12} represents the point of

departure from the conventional theory, interpreted as a resonance between atom systems in K_1 and K_2 excited sub-levels for which the separation $\Delta\nu$ is less than the corresponding line breadths, and which emit photons of approximately the same frequency. Expressions are deduced for γ_i' (now time dependent) in the case $P_{12} \neq 0$ and the method of determining the corresponding probability amplitudes and shapes of the lines is indicated. The method is then applied to the particular case $P_1 = P_2 = P_{12}$ which seems to approximate to the conditions for elements for which the anomalies in broadening are predicted in the usual theory. When $\Delta\nu$, the hyperfine structure separation, is zero, the breadth $(2\gamma_i/\pi)$ is double that given by the usual theory, an effect linked with the fact that two electrons only can occupy the K shell. When $\Delta\nu$ is large, the line is resolved into two separate lines each of width (γ_i/π) given by the usual theory and whose maxima are separated by $\Delta\nu$. When $\Delta\nu$ is small but finite, a trough of zero intensity appears at the centre of the line, such that the line of breadth $2\gamma_i/\pi$ is divided into two parts. The fractional broadening is then of the second order in $\Delta\nu$ and is calculated to be less than the experimental error. The theoretical formulation suggests that the atom should be considered in its ensemble as passing from a condition of K excitation to one of L excitation, in preference to the one electron conception in which the electron falls from the L shell to the K shell.

H. H. GREENWOOD

537.531 : 535.33 : 539.166.83

5501. Study of L spectra excited by internal conversion. M. Riou. *J. Phys. Radium*, **13**, 593–600 (*Dec.*, 1952) *In French.*

Experimental and theoretical results are quoted to show how the relative probabilities for excitation of the three L sub-levels vary with the mode of excitation (electron bombardment, photoelectric effect, or internal conversion). Measurements of the L X-ray spectra and fluorescent yields following internal conversion are discussed in relation to theoretical calculations, showing the value of such measurements, e.g. in indicating the modes of de-excitation of the L sub-levels.

J. J. WILKINS

537.531 : 535.343

5502. X-ray absorption spectra of molybdenum in the compounds $(NH_4)_2MoO_4$, $K_4Mo(CN)_8$ and MoS_2. R. L. Barinskiĭ. *Dokl. Akad. Nauk SSSR*, **83**, *No.* 3, 381–4 (1952) *In Russian.*

The structure of the L_{III} absorption edge of Mo is found to be strongly dependent on the type of bonding in the compound. Absorption lines in the L_{III} spectrum in $(NH_4)_2MoO_4$ are due to the transition of $2p$ electrons to levels near $4d$. Compounds in which $4d$ levels are used in bonds are characterized by the absence of sharp absorption lines.

A. L. MACKAY

537.531 : 535.33

5503. Multiplicity in X-ray emission spectra. I. B. Borovskiĭ and T. M. Golovner. *Dokl. Akad. Nauk SSSR*, **88**, *No.* 2, 233–6 (1953) *In Russian.*

The observed multiplicities in the M emission spectra of the rare earth elements can be explained if an interaction between the $3d$- and $4f$-states is assumed. If this is not the case the selection rules will be infringed. The difference between the total moments of upper and lower states should be half an integer. It is probable that a series of anomalies, in particular the presence of satellites of principal lines, can be accounted for by interaction between unfilled nd-levels and deeper $(n-l)p$ levels.

A. L. MACKAY

537.531 : 535.343

5504. Use of the magnitude of the jump in the coefficient of X-ray absorption for the calculation of the fine structure of the fundamental edge. R. L. Barinskiĭ, É. E. Vaĭnshteĭn and K. I. Narbutt. *Dokl. Akad. Nauk SSSR*, **82**, *No.* 3, 355–8 (1952) *In Russian.*

Data from Glaser [Abstr. 5451 (1951)] on absorption by Ge in various compounds are used for verifying the equation relating the ratio of absorption line intensities and effective quantum number, the latter being found spectroscopically. The structure of the edge can be calculated using successive approximations. The method can give useful information on the state of combination of certain atoms in compounds.

A. L. MACKAY

537.531 : 535.343

5505. The relation of the structure of the fundamental X-ray absorption edge to the X-ray emission spectra for atoms in molecules and polar crystals. K. I. Narbutt, É. E. Vaĭnshteĭn and R. L. Barinskiĭ. *Dokl. Akad. Nauk SSSR*, **87**, *No.* 3, 381–4 (1952) *In Russian.*

Descriptive review of previous work, principally by the authors. Instances are collected of calculation of ionization potential and of emission spectra from absorption edge data confirming the author's theory of the fine structure of the latter.

A. L. MACKAY

537.531 : 535.343

5506. The structure of the fundamental X-ray absorption edge of atoms in polar crystals and its connection with the ultraviolet absorption. É. E. Vaĭnshteĭn, K. I. Narbutt and R. L. Barinskiĭ. *Dokl. Akad. Nauk SSSR*, **82**, *No.* 5, 701–4 (1952) *In Russian.*

The X-ray spectrum of K and Cl in KCl is a superposition of two series with the same limit having effective quantum numbers 1·60 and 1·26. The ratio of the first lines to the pure edges calculated from data for argon are in satisfactory agreement with experiment. An energy diagram is given for emission and absorption spectra of KCl.

A. L. MACKAY

537.531 : 535.343

5507. The structure of the X-ray absorption edge of atoms of transition elements in chemical compounds. R. L. Barinskiĭ, É. E. Vaĭnshteĭn and K. I. Narbutt. *Dokl. Akad. Nauk SSSR*, **83**, *No.* 2, 199–202 (1952) *In Russian.*

No single theory seems able to account for all the phenomena connected with the presence of an additional maximum on the long-wave side of the K, L_I, M_{II} and M_{III} edges in transition elements. The problem is discussed in the light of previous work (preceding abstract) showing the existence in ionic crystals of discrete energy levels to which K electrons of atoms in the compound can be raised. The

probability of such transitions is different for each component in the ionic crystal. A. L. MACKAY

537.531 : 535.345 : 537.561

5508. The structure of the fundamental X-ray absorption edge for ions in solution. K. I. NARBUTT, R. L. BARINSKIĬ AND É. E. VAĬNSHTEĬN. *Dokl. Akad. Nauk SSSR*, **82**, *No.* 4, 567–70 (1952) *In Russian.*

Solutions of Mn, Ni, Cu and Zn were examined. The *K* ionization potentials were found to be the same as those found optically. The widths of absorption lines were slightly increased. Agreement between theory and experiment was obtained when the ionic charge was put equal to 3. The relationship giving the ratio between the true absorption edge and the first selective line was found to be only qualitatively valid. A. L. MACKAY

537.531 : 535.82

5509. The X-ray shadow microscope. V. E. COSSLETT AND W. C. NIXON. *J. appl. Phys.*, **24**, 616–23 (*May*, 1953).

Shadow projection permits higher resolution and simpler operation than other methods of X-ray microscopy. A point source, less than 1 μ in diameter, is obtained by the use of magnetic electron lenses and used for projecting shadow images at a primary magnification up to 100× with an exposure time in the order of minutes. The use of a metal foil as target and tube window insures high intensity at the specimen, which is in air. A resolving power little short of the best optical performance has been obtained with an accelerating voltage of 10 kV. The practical limitations to resolution, contrast and exposure time are discussed in detail. A resolution of 100 Å should be practicable, but only with longer X-rays and an exposure of the order of 1 hour. A.

537.531 : 778.33

5510. A simple X-ray micro-beam technique. L. C. SPARK. Letter in *Nature* [*London*] **171**, 695 (*April* 18, 1953).

The apparatus described is intended for the examination of plant cells; lead glass capillaries and metal pinholes being found unsuitable. An X-ray beam, collimated by two ½ mm pinholes 50 mm apart, is further collimated by tilted metal plates. The corners of the plates define the beam, which is 30 μ wide, and the edges prevent scatter from these corners reaching the photographic film. J. THEWLIS

537.531 : 621.386.1 : 620.179.152 : 778.33

5511. Uses of low voltage X-ray tubes with thin beryllium windows in non-destructive testing. T. H. ROGERS. *Non-destr. Test*, **11**, 34–9 (*March*, 1953).

High output of the AEG 50 and OEG 60 tubes allows spotweld radiography of Al alloys at 20–25 kV, microradiography of alloy sections for grain structure, thickness gauging of Al and plastic foils by direct penetration, and chemical analysis, e.g. of stainless steel, by measuring proportions of characteristic radiation from the component elements. Curves relating window thickness to wavelength show that even at 5 Å, 10% X-ray output can be obtained with a 0·2 mm window, now being made experimentally. F. T. FARMER

CATHODE RAYS . POSITIVE RAYS 537.533/.534

537.533.71

5512. Space charge spread of reflected electron beams studied by a photographic method. J. T. WALLMARK. *J. appl. Phys.*, **24**, 590–7 (*May*, 1953).

The spread of electron beams of rectangular cross-section is studied (*a*) in a field-free space, (*b*) in a reflection space. An experimental method is tried to trace the electron paths from the excited gas molecules left behind by directly photographing the beam in a high vacuum. The results are checked with published theoretical calculations in case (*a*), and with results obtained through an iterative method in case (*b*). A.

537.533.72

5513. Potential and field of a cylindrical electrostatic lens with three apertures. M. LAUDET. *Cahiers de Phys.*, *No.* 41, 73–80 (*Jan.*, 1953) *In French.*

Presents a theoretical analysis of the potential and field distributions in the general case of a cylindrical lens formed by apertures in three parallel plane electrodes. The important case of a symmetrical lens is studied and a numerical calculation of the potential and field distributions in the plane of symmetry is shown graphically. An abacus gives the relationship between the theoretical parameters and the geometry of the system. Finally, the procedure for studying immersion objectives is given. W. BARDSLEY

537.533.72

5514. Electron lenses useful for particles of high energy. Calculation of trajectories. M. Y. BERNARD. *C.R. Acad. Sci.* [*Paris*] **236**, 902–4 (*March* 2, 1953) *In French.*

Calculates the trajectories of high-energy particles in the lenses recently described [Abstr. 3350 (1953)]. The converging power is greater than for other types of lens with the same potentials. A. H. W. BECK

537.533.72 : 535.41

5515. Electron beam interferometer. L. MARTON, J. A. SIMPSON AND J. A. SUDDETH. Letter in *Phys. Rev.*, **90**, 490 (*May* 1, 1953).

Describes an experimental arrangement for realizing the electron beam interferometer envisaged in a previous paper [Abstr. 5153 (1952)]. Three Cu crystals are used about 100 Å in thickness and 3 mm in dia., mounted in place of the object chamber of a conventional electron microscope. The fringes are difficult to observe owing to low intensity, but could be used for wavelength determinations or field gradient studies. Owing to the "achromatic" properties of this type of interferometer it cannot be used, for example, for studying the coherence of the beams from electron emitters. Arrangements for doing this are being studied. J. THEWLIS

537.533.72

5516. The JENER beta-spectrometer. G. TRUMPY. *JENER Rep.*, *No.* 10, 13 *pp.* (1952).

Different qualities, such as the properties of the magnetic lens and the construction of the spectrometer chamber, are given. The alignment of the spectrometer axis with the magnetic field has been performed, using a method described by Versten. The field distribution on the axis has been measured.

This permits construction of paraxial rays. Focusing properties are best studied by using the spectrometer as a cathode-ray tube. Results from these measurements are plotted in such a way that the effect of focusing baffles is easily shown in the graph. Baffles are constructed, considering the best possible resolving power $p/\Delta p$ at a given transmission ω. The resolving power can be changed by moving one of the baffles along the spectrometer axis. Spectra from Co^{60} and Cs^{137} are measured. The connection $p = (292 \pm 3)I$ is found. A study of the performance gives $\Delta p/p = 1{\cdot}3\%$ at $\omega = 0{\cdot}84\%$ and $\Delta p/p = 0{\cdot}55\%$ at $\omega = 0{\cdot}033\%$. A.

537.533.72

5517. A [Tricker] β-spectrometer with uniform magnetic field. P. Bretonneau and J. Moreau. *J. Phys. Radium*, **14,** 25–30 (*Jan.*, 1953) *In French.*

It is shown that for a point source and ring-focusing (i.e. selection of a section of the caustic), the proportion of 4π which is collected is $f(\alpha)[\delta(H\rho)/H\rho]^{\frac{1}{2}}$, where α is the angle of emission with respect to the field and $f(\alpha)$ has a maximum at $\alpha = 45° 37'$. The problem of a finite area of source has been solved graphically, for a source of diameter equal to that of the annular aperture at the receiver; the optimum value of α is about 42°, but little is lost in choosing, for economy of field, $\alpha = 29° 30'$, as the authors have done in an apparatus of which constructional and performance data are given. Total width at ½ height of the F line of ThB was 1%. Source-receiver distance is about 80 cm and max. field 1200 gauss. J. C. E. Jennings

537.533.74

5518. Non-elastic resonance scattering of electrons in metals. A. Ya. Vyatskin. *Zh. eksper. teor. Fiz.*, **23,** *No.* 2 (8) 147–50 (1952) *In Russian.*

On the basis of previous work [Abstr. 8791 (1950)] it is possible to describe the scattering by a wave-function model which imposes conditions on the Coulombic interaction of the electrons with those of the lattice. The condition is that similar electrons in the event, if their energy is equal to the energy of the outer zone which coincides with the condition of electron diffraction, will be non-elastically scattered. W. Bardsley

537.533.74

5519. A simple derivation of the scattering formula of Bhabha. K. Baumann. *Acta phys. Austriaca*, **7,** *No.* 1, 96–7 (1953) *In German.*

Bhabha's cross-section for scattering of positrons by electrons is verified very directly, using some previous results of the author [Abstr. 2186 (1953)]. R. H. Dalitz

537.533.8

5520. On the depth of the output of secondary electrons. N. M. Budynskiĭ. *Dokl. Akad. Nauk SSSR*, **82,** *No.* 5, 705–8 (1952) *In Russian.*

Experimental investigation of a wedged-shaped film of silver superimposed on aluminium or mica. It was found that the coefficient of the secondary electron emission decreases with the decrease in thickness of the film of silver. The thickness d_0 of the silver film at which the decrease of the coefficient of emission starts depends on the energy of primary electrons. This coefficient was measured in the region of the wedge where its thickness $> d_0$ is a constant. Z. F. Wojnar

537.533.9

5521. Quantum theory of the radiating electron. N. F. Nelipa. *Dokl. Akad. Nauk SSSR*, **85,** *No.* 6, 1259–62 (1952) *In Russian.*

The calculations of Parzen [Abstr. 330 (1952)] on the radiation from an electron moving in a uniform magnetic field are criticized. Papers on the same subject have been published by Judd *et al.* [Abstr. 5158 (1952)] and Olsen and Wergeland [Abstr. 5159 (1952)]. Nuclear Science Abstracts

537.533.9

5522. Research on film dosimetry. *Atomics* [*London*] **4,** 91–4, 98 (*April*, 1953).

Describes the construction of an extrapolation chamber and film badge holders used to calibrate two types of dental X-ray film in electron beams of 0·5–1·4 MeV. Over this range, photographic density was linearly proportional to dosage and independent of electron energy. D. V. Mabbs

537.534 : 621.384.62

5523. Phase debunching by focussing-foils in a proton linear accelerator. J. S. Bell. *Atomic Energy Res. Establ.* [*Harwell*] *Mem. T/M* 68, 12 *pp.* (1952).

The statistical variation of energy loss of particles traversing focusing-foils in a Berkeley type accelerator leads to phase debunching. A treatment of the effect is developed which is based on an analysis by Landau of straggling in single foils. The method is valid for small bunches. Calculations are done for a 47–470 MeV machine with operating wavelength 1·5 m, energy gradient 2·3 MeV/m, and synchronous phase 20°. With 3×10^{-4} in. beryllium foils the final bunch width is quite tolerable, being of the order of a few degrees. The foils may be somewhat thicker without affecting the overall bunch width, but it varies inversely with the square root of the wavelength. A.

537.534

5524. On the molecular evaporation of group IVB elements. R. E. Honig. Letter in *J. chem. Phys.*, **21,** 573–4 (*March*, 1953).

Ge and Sn, evaporated in a Dempster-type mass spectrometer showed, in addition to multiply-charged ions, ion clusters of up to six atoms. Graphs are presented showing the intensities of the ion currents in relation to the number of atoms per cluster. F. Lachman

537.534.72 : 621.319.5

5525. The effective length of an electrostatic analyzer. J. E. Monahan. *J. appl. Phys.*, **24,** 434–8 (*April*, 1953).

Calculations are made concerning a 40 in. radius, 90° electrostatic analyser for accurate determination of ion-beam energy at the Argonne National Laboratory. A modified Schwartz transformation is used to find the effective lengths allowing for the finite spacing and rounded corners of the deflector plates. The correction for rounded corners is somewhat greater than 0·05% and it is hoped that a final absolute accuracy of measurement of 0·1% should be obtainable. J. H. Fremlin

537.534.72

5526. A practical method for the correction of angular aberration in mass spectrometry. C. CASSIGNOL. *J. Phys. Radium*, **14**, 31–4 (*Jan.*, 1953) *In French.*

An empirical method is described for correcting this aberration. By using a modulated ion accelerating voltage, the collector current can be displayed on a c.r.o., and the effect of changes in magnet profile immediately observed. J. HUGHES

537.534.72

5527. An electromagnetic separator for isotopes of light and medium elements. R. BERNAS. *J. Phys. Radium*, **14**, 34–42 (*Jan.*, 1953) *In French.*

Based on a 60° sector magnet; a very intense ion beam can be used because of a method of space-charge neutralization. For solid sources ~10 mA of focused ions is obtained from a cold cathode discharge in a magnetic field. Yields of the order of 10–100 mg/day for isotopes of Zn, Sb and Hg have been obtained. J. HUGHES

537.534.75

5528. The range-energy relation for protons of intermediate energy in air. W. E. BURCHAM. Letter in *Phil. Mag.*, **44**, 211–13 (*Feb.*, 1953).

Using recent measurements of ranges of (d, p) protons in air, mica or Al for energies (2–12 MeV) known from accurate Q-values, the theoretical formula of Livingston and Bethe (1937) is satisfactorily verified. W. J. SWIATECKI

537.534.75 : 539.164.75 : 539.18

5529. Energy loss of highly charged particles produced by fission and by cosmic rays. III. The linear density of delta rays. Experiments. P. DEMERS AND Z. LECHNO-WASIUTYNSKA. **IV. The linear density of delta rays. Theoretical.** Z. LECHNO-WASIUTYNSKA. *Canad. J. Phys.*, **31**, 480–96 (*May*, 1953).

For Pt II, see Abstr. 1928 (1953). Delta-rays having an energy as low as 2–5 keV have been counted along the tracks of mesons, protons and α-rays of low velocity, allowing the identification of each. Three methods are presented and applied to determine the efficiency f of counting δ-rays of various energies; measured values of f vary between 0·05% at 2 keV and 100–180% near 50 keV. The number of grains, and the energy distribution among visible δ-rays, are analysed. A new method of determining velocity, based on the analysis of the number of grains in the δ-rays, is presented. In Pt IV, the effect of relativistic corrections is computed and discussed. It is small except at large velocities where comparison with experiment is difficult. A.

537.534.75 : 778.34

5530. On the range-energy curves for positive ions of charge greater than 1 in nuclear emulsions. J. P. LONCHAMP. *J. Phys. Radium*, **14**, 89–95 (*Feb.*, 1953) *In French.*

A review is given of published experimental range-energy relationships for α-particles in various Ilford emulsions, and, based on this data, a range-energy curve is proposed for α-particles of energy 0–10 MeV in Ilford C2 emulsions. For particles of charge greater than 2, a relation of $R_v = R_{\alpha v}M/Z^2 + C$ is proposed, where R_v is the range of a particle of charge Z and mass M having a velocity v, and $R_{\alpha v}$ is the range of an α-particle having the same velocity. C is a function of Z and M which takes into account the variation of the effective charge of the particle near the end of its range. Values of C are given for $3 \leqslant Z \leqslant 14$. A. C. COATES

537.534.75 : 778.34

5531. On a new method of determining the masses of charged particles by means of photoemulsions. I. V. V. CHAVCHANIDZE. *Zh. eksper. teor. Fiz.*, **23**, *No.* 5 (11) 502–11 (1952) *In Russian.*

The theory of a method which would yield the mass and energy of a particle from the simultaneous measurement along a track of the radial and angular deviations from a straight line. This is connected with the observation that the ionization loss has a significant influence on the variation of the above distribution functions. Inaccuracies due to physico-chemical imperfections of the emulsion would thus be avoided. W. J. SWIATECKI

DISCHARGE TUBES . COUNTERS 537.54

537.542

5532. A new general method of extraction in ion sources: applications to different types of source. I. Discussion of the principles of the method. J. SOMMERIA. *J. Phys. Radium*, **13**, 645–50 (*Dec.*, 1952) *In French.*

This paper follows a previous note [Abstr. 1694 (1953)]. A new arrangement of electrodes near the exit canal of a positive ion source is described and discussed qualitatively, and different extraction electrode systems are shown in figures. J. D. CRAGGS

537.542

5533. A new general method of extraction in ion sources: applications to different types of source. II. Experimental results. J. SOMMERIA. *J. Phys. Radium*, **13**, 651–7 (*Dec.*, 1952) *In French.*

Gives detailed exptl. results for sources built according to the principles discussed in an earlier paper (preceding abstract). The new extraction method was applied to sources of the types due to Heil and Finkelstein. The former gave 77 μA/W for the total ion beam current at a gas consumption (hydrogen) of 9 cm³/hour. The latter, for which comparable figures are not given, showed that some 30% of the total discharge current appeared as ion beam. A brief discussion of other sources is given.

J. D. CRAGGS

537.542 : 539.164.08

Precision counting of alpha particles with special reference to the determination of standard sources. *See Abstr.* 5682

537.542 : 621.387.42

5534. Detection of β- and γ-rays with counter tubes. H. FARK. *Frequenz*, **6**, 357–63 (*Dec.*, 1952) *In German.*

Generally reviews the construction and operation of tubes with different counter circuits; details effect

of tube materials and gas filling, outlines typical counters and integrating circuits and mentions two commercial radiation monitors. E. D. HART

537.542

5535. On the number of spurious impulses. M. I. PODGORETSKIĬ. *Dokl. Akad. Nauk SSSR*, **82**, *No.* 6, 881–4 (1952) *In Russian.*

The number of accidental registrations of an ionization chamber due to a background is calculated (as function of the threshold for activation of the counter) in the case of a long "dead" period ; and is found to be always less than for short τ.

W. J. SWIATECKI

537.542 : 539.172.4

5536. Calibration of boron ionization chambers indicating pile power-level, by a measurement of reactivity. V. RAIEVSKI. *C.R. Acad. Sci.* [*Paris*] **236**, 1251–2 (*March* 23, 1953) *In French.*

The multiplication factor (k) of the pile is measured for a sub-critical condition, and the corresponding power-level is calculated. Sensitive detectors, calibrated at this low power, may then be used for calibration of the ionization chambers at normal powers, with an estimated error of $\pm 15\%$.

J. J. WILKINS

537.542 : 539.172

5537. A new method of measuring angular distributions. R. BATCHELOR AND B. H. FLOWERS. *Atomic Energy Res. Establ.* [*Harwell*] *Rep. N/R* 166, 4 *pp.* (1948).

A method is suggested for the investigation of angular distributions of charged particles emitted in disintegrations by the measurement, effectively, of pulse shape from an ionization chamber; and an experiment to test the method is described. Curves showing the variation in pulse shape with angle are presented. The results indicate that a *P*-wave component of the order of 5% could be measured in an otherwise isotropic distribution at the energy used. A.

537.542

5538. Elementary theory of generating functions. Application to statistical fluctuations of scintillation counters. P. MAIGNAN, D. BLANC AND J. F. DETŒUF. *J. Phys. Radium*, **13**, 661–7 (*Dec.*, 1952) *In French.*

The generating function employed is $G(z) =$ expected value of z^r, where r is a random variable taking values 0, 1, 2 . . . Using two basic theorems, one on sums and the other on chains of a number of such random variables, results on the distribution of numbers of scintillations observed, and their intensity as measured by a multiplier, are derived.

N. L. JOHNSON

537.542 : 621.387.464

5539. Slow neutron scintillation detector. A. LUNDBY, K. SKARSVÅG AND E. ANDERSEN. *JENER Rep.*, *No.* 13, 4 *pp.* (1952).

A LiI(Sn) crystal has been used in conjunction with an EMI 5311 photomultiplier tube to detect slow neutrons. The spectrum of pulses due to the $Li^6(n, \alpha)$ reaction in the crystal was recorded, and a resolution of 18% for uncollimated neutrons was obtained. The crystal has a decay time of about 0·2 μsec. It responds linearly with the energy deposited in the crystal. A simple biased electronic amplifier has been developed, which consists of a single EFP 60 secondary emission pentode with positive feedback. The pulses from the photomultiplier trigger this circuit directly, and output pulses are produced which operate a scaling unit. A.

537.542 : 621.387.42

5540. Cold cathode counting tube. D. S. PECK. *Bell Lab. Record*, **31**, 127–9 (*April*, 1953).

A brief description of a counter tube containing 20 cathodes to which, in succession, a glow discharge may be transferred. The tube will respond at pulse repetition rates varying up to 12 000/sec, and useful lives of thousands of hours have been obtained.

J. D. CRAGGS

537.542 : 621.318.572

5541. Decades with four double-triodes. R. WAHL. *J. Phys. Radium*, **13**, 670–1 (*Dec.*, 1952) *In French.*

Describes the most economical circuit for a scale-of-10 counter. This uses a scale of 16 with feedback between stages and requires 4 double-triodes and 4 Ge diodes. Operating from negative pulses, the sensitivity was 12 V + 40% for 1 μsec pulses. Resolving time = 2·5 μsec, h.t. = 250 V ± 40%, l.t. = 6·3 V ± 40% component; tolerance = 10%.

A. H. W. BECK

537.542 : 621.318.572

5542. Pulse amplitude analysis in nuclear physics. E. W. TITTERTON AND R. S. WILSON. *J. Brit. Instn Radio Engrs*, **13**, 173–80 (*March*, 1953).

Reviews pulse-sorting techniques, with special reference to discriminator circuits and gives a short account of c.r.t. discriminators. J. D. CRAGGS

537.543 : 621.385.16.029.6

5543. Statistical theory of the magnetron (static conditions). G. YA. LYUBARSKIĬ AND L. É. PARGAMANIK. *Dokl. Akad. Nauk SSSR*, **84**, *No.* 3, 491–4 (1952) *In Russian.*

The electron cloud is regarded as an ideal gas in statistical equilibrium, to which a "self-adjusting" field, the average of the real field, is applied externally; deviations from the real field are fluctuational and are regarded as collisions which maintain the equilibrium state. This leads to results in better agreement with experimental results than Hull's mechanical theory (1924): while it gives the same electron density as that theory, it gives electron gas temperatures within a few % of eF (F is the applied potential difference) which is of the order of magnitude of those measured, and anode characteristics which reproduce the essential features of the measured ones, including the "displacement" phenomenon and the existence of an appreciable anode current at high field strengths. For small currents the theory uniquely determines that state of the electron gas and the working conditions of the magnetron with given magnetic field, applied potential difference, and emission current. It cannot describe the feedback phenomenon, so important at large emission currents, because of its non-statistical nature. R. C. MURRAY

IONIZATION . THERMIONICS 537.56/.58

537.56

5544. Active nitrogen. S. K. MITRA. *Phys. Rev.*, **90**, 516–21 (*May* 15, 1953).

Criticisms have been made of the ionic theory of active nitrogen, proposed by the author some years ago, on the ground that experiments carried out since then with the specific purpose of detecting N_2^+ ions in the glowing gas have yielded negative results. Need is felt therefore for re-examining the older theories, in particular the atomic theory and its variations. It is shown in the paper that by collating the suggestions made in respect of this theory in recent years one may make the following hypothesis: Active nitrogen is a mixture of nitrogen atoms in the ground state ^4S and the metastable states ^2D and ^2P (the last named in small proportion) produced by dissociative recombination of N_2^+ ions and electrons always present in a strong electric discharge in nitrogen. The N_2^+ ions and electrons are thus the parent bodies of the active substance instead of being themselves the active substance, as had been proposed in the ionic theory. The reason the production of the atoms is supposed to be due to dissociative recombination and not to electronic bombardment of N_2 molecules, is that it has been known for a long time that the production of active nitrogen is closely associated with the presence and production of N_2^+ ions. The two outstanding properties of active nitrogen (besides its chemical activity), e.g. long-duration afterglow emitting its characteristic band spectrum, and the invariable presence of ionization in the glowing gas, are thus explained as follows: The nitrogen atoms recombine by a preassociation process (as first suggested by Gaydon) to produce N_2 molecules in the high vibrational levels of the B state from which the first positive bands, with the characteristic intensity distribution, are emitted. The long life of the afterglow is explained as resulting from the fact that the wall recombination of the N atoms is prevented by the formation of an adsorbed layer of N_2 molecules on the wall surface. (Formation of such an adsorbed layer was also assumed in the ionic theory.) The invariable presence of ionization in the glowing gas is explained as resulting from ionizing recombination of metastable atoms, $N(^2D) + N(^2P) \rightarrow N_2^+ + e$. Possible explanations of the negative temperature coefficient of the glow intensity, of the so-called dark modification, and also of some of the other properties of active nitrogen, are suggested. A.

537.583 : 621.385.032.216

5545. On thoria cathodes. G. MESNARD. *C.R. Acad. Sci.* [*Paris*] **236**, 904–6 (*March* 2, 1953) *In French.*

Recent experiments include: the observation that: (1) the spectral emissivity increases sharply with operation in the temperature range 1900–2000°K; (2) an activation is possible at temperatures below 1950°, and occurs without evolution of O_2, while activation at 1950°K must be carried out with current and is irreversible, purely thermal treatments requiring much higher temperatures. When activated, drawing current reduces the activity. The following model is proposed: "N" type semiconductor with vacant oxygen sites, top of filled band 6·5 eV below the conduction band; surface work function 1·0 eV in well-activated state. A. H. W. BECK

537.583 : 621.385.032.216 : 621.317.332.1

5546. A simple method for measuring interface impedance. A. VAN DER ZIEL. Letter in *J. appl. Phys.*, **24**, 496 (*April*, 1953).

An outline of an experimental method for measuring the resistance and capacitance of the interface layer developed with ageing between the nickel cathode and its oxide coating in a vacuum tube. M. R. HOPKINS

537.585

5547. On the preparation of some solid ion sources in the induction furnace and the solar furnace. G. COUCHET. *C.R. Acad. Sci.* [*Paris*] **236**, 1240–2 (*March* 23, 1953) *In French.*

Describes the manufacture of homogeneous planar surfaces which could be optically polished, using the alumino-silicates $R_2O \cdot Al_2O_3 \cdot 2SiO_2$ (where R = Li, Na or K). The melting was carried out in alumina crucibles in an induction furnace or by melting a localized area in the centre of one face of a block of the material, using solar energy focused by a 150 cm lens. The purity of the fused material was thus the same as that of the original. A. H. W. BECK

COSMIC RAYS 537.591

537.591

5548. An experiment on cosmic rays. P. G. GUEST AND W. M. SIMMONS. *Amer. J. Phys.*, **21**, 357–62 (*May*, 1953).

An experiment suitable for an undergraduate laboratory course is described. A two-counter cosmic-ray telescope is employed in conjunction with a Rossi-type coincidence circuit. Details of the circuits are given. The methods of calculating the intensities of the cosmic rays are discussed, and a typical set of experimental results is shown. These results are used to illustrate the statistics of the rate of arrival of cosmic-ray particles. A.

537.591.1

5549. The energy spectrum of the non-equilibrium soft component of cosmic rays. I. L. ROZENTAL'. *Zh. eksper. teor. Fiz.*, **22**, *No.* 1, 92–101 (1952) *In Russian.*

An attempt to explain the observed excess of the soft component over what can be accounted for by μ-decay is made by deriving the equation governing the spectrum of an electron cascade generated by a nucleon component, assuming an exponential absorption of the latter and a simple rule for the creation of the electrons. The general trend, illustrated by a numerical example, is for the resulting "non-equilibrium" component to fall off more rapidly with energy than the equilibrium component.

W. J. SWIATECKI

537.591.1

5550. A study of the composition of cosmic rays at a height of 1000 m above sea level. N. M. KOCHARYAN, G. S. SAAKYAN, M. T. AÏVAZYAN, Z. A. KIRAKOSYAN AND S. D. KAÏTMAZOV. *Zh. eksper. teor. Fiz.*, **23**, *No.* 5 (11) 532–42 (1952) *In Russian.*

Using a large magnet (useful space $80 \times 20 \times 10$ cm)

with horizontal sets of double trays of crossed counters to define the co-ordinates of 3 points on the path of a particle, and sets of Cu absorbers (22, 6·3, 7·8, 8·4, 10·1 g.cm^{-2}) interspersed with trays of counters to delimit the energy, a study was made of the mass spectrum of mesons and the momentum spectrum of protons. The μ^+, μ^- meson peaks give masses $(211 \pm 3)\, m_e$ and $(212 \pm 3)\, m_e$ respectively. The number of π's is <5% of the μ flux. The ratio of +ve to −ve particles decreases from 1·24 for momenta $(11\text{–}35)\times 10^8$ eV/c to 0·9 for $(2\text{–}3{\cdot}6)\times 10^8$ eV/c. The proton spectrum shows a tail on the high energy side. A theoretical estimate shows that this can be understood in terms of the non-ionizing nuclear collisions which become important at higher energies. A similar estimate is made for π-mesons.

W. J. SWIATECKI

537.591.1

5551. On particles with masses 600–1000m_e in the composition of cosmic rays. A. ALIKHANYAN, A. DADAYAN AND N. SHOSTAKOVICH. *Dokl. Akad. Nauk SSSR*, **82**, *No.* 5, 693–6 (1952) *In Russian.*

Using the arrangement of the preceding abstract at 3250 m, peaks at 580 and 950 m_e were found in the frequency distribution of particles. W. J. SWIATECKI

537.591.1

5552. Particles of mass intermediate between those of the meson and the proton. A. ALIKHANYAN AND V. KHARITONOV. *Dokl. Akad. Nauk SSSR*, **85**, *No.* 2, 295–8 (1952) *In Russian.*

The division of these particles into "light" (masses $< 700\, m_e$) and "heavy" (masses 700–2200 m_e), previously proposed on the basis of momentum and range (preceding abstract), has now been substantiated by measurements of ionizing capacity, the average value of which is > that of mesons of the same momentum, and ⩾ that of π- and μ-mesons, stopped by the filters used, but is <that of protons. It is shown that these particles cannot be non-ionizational residues of π-mesons, and also that they cannot include particles generated in the filters and moving from below to above, as suggested by Powell [Abstr. 631 (1951)]. R. C. MURRAY

537.591.15

5553. The scattering of cascade particles in heavy elements. S. Z. BELEN'KIĬ AND B. I. MAKSIMOV. *Zh. eksper. teor. Fiz.*, **22**, *No.* 1, 102–11 (1952) *In Russian.*

A recurrence formula is derived for the nth moment of the distribution-in-depth function of an electron-photon cascade including scattering. The angular distribution, averaged over depth, is calculated without assuming small angles and including ionization losses (which are found to be unimportant for energies ⩾ 15 MeV). In the case of a 10^8 eV cascade in Pb the first 2 moments of the cascade curve are changed by a few % due to scattering.

W. J. SWIATECKI

537.591.15

5554. On the cascade curve in heavy elements. V. YA. FAINBERG. *Zh. eksper. teor. Fiz.*, **22**, *No.* 1, 112–19 (1952) *In Russian.*

Using Belen'kiĭ's method of recurrence formulae (preceding abstract) the first 2 moments of the depth distribution function of an electron-photon cascade are calculated for an arbitrary primary photon spectrum. The case of an E^{-1} spectrum is solved analytically. W. J. SWIATECKI

537.591.15

5555. Cascade processes in extensive atmospheric showers of cosmic rays. I. L. ROZENTAL'. *Zh. eksper. teor. Fiz.*, **23**, *No.* 4 (10) 440–55 (1952) *In Russian.*

A phenomenological study of the cascade produced by a high energy nucleon ($E_0 \sim 10^7$ BeV) supposed to consist of nucleons and π-mesons interacting with air nuclei with geometrical cross-sections. Charged π's decay, producing a μ-meson component, neutral π's give two γ's which initiate an electron-photon cascade. The "nuclear" cascade (i.e. nucleons + π) is assumed to cease with energies <10 BeV. The general features of the individual collisions are taken according to Fermi's statistical theory. The number of secondaries is assumed to be E^ν (E = energy of primary, ν = const.), of which a fraction b are nucleons. The equations describing the development of the cascade are used to evaluate (as functions of the depth) the mean square radii of the various components of the cascade (including electrons), their density distributions and the ratios (nucl. + π + μ)/(nucl. + π + μ + e) and (π + prot.)/(neutr.). Comparison with experiments suggests $\nu = \frac{1}{4}$, $b = \frac{3}{4}$. This case is studied in more detail and graphical results are given. 38 references.

W. J. SWIATECKI

537.591.15

5556. Auger showers in the atmosphere. A. DAUDIN AND J. DAUDIN. *J. Phys. Radium*, **14**, 169–74 (*March*, 1953) *In French.*

Extensive air showers have been studied at Pic du Midi (2860 m) using counter sets with separations of 5 m and 80 m. The barometer coefficients were found to be $-10{\cdot}6 \pm 2$ and $-10{\cdot}4 \pm 0{\cdot}16$% per cm Hg respectively. A temperature coefficient of $-0{\cdot}1$% per °c was found for showers of 5 m separation. After correcting for barometric changes there was still a correlation between the daily rates of showers measured at the two separations indicating the presence of intensity changes due to some other cause. H. ELLIOT

537.591.15

5557. Observations of extensive cosmic-ray showers below ground. E. P. GEORGE, J. W. MACANUFF AND J. W. STURGESS. *Proc. Phys. Soc.* [*London*] *A*, **66**, 346–56 (*April*, 1953).

The decoherence curve of extensive showers has been studied at a depth of 60 m water equivalent below ground out to a distance of 320 m. The relative frequencies of coincidences in various combinations of counter sets are found to be consistent with the assumption that the frequency of showers containing N particles is proportional to $N^{-\gamma}$ with $\gamma = 3{\cdot}2 \pm 0{\cdot}2$. By comparison with observations at other depths it is concluded that the particles in extensive showers are absorbed less rapidly in the earth than the normal particles of the vertical component. The observed showers can be readily understood in terms of the small fraction of penetrating particles (presumed μ-mesons) that is known to exist

in extensive showers observed at sea level. At counter separations less than 3 m the observed coincidences are much too frequent to be attributed to extensive showers, indicating a significant contribution from locally produced penetrating particles. The origin of these secondary particles is discussed. A.

537.591.3

5558. The absorption of the star-producing component of cosmic rays at an altitude of 4000 m. Zh. Takibaev, M. Ostyakov and D. Kaidov. *Zh. eksper. teor. Fiz.*, **23**, *No.* 4 (10) 456–60 (1952) *In Russian.*

Plates in vertical and horizontal positions completely enclosed in absorbers of 0, 1·5, 4, 12 cm Pb were exposed for 30 days. The number of single tracks as function of absorber thickness indicates a maximum around 2 cm Pb: slight for tracks longer than 50 μ, pronounced for shorter tracks. The decrease beyond the maximum is consistent with a cross-section $4A^{2/3}\times10^{-26}$ cm^2 for the absorber nuclei. The plot of the number of larger stars also gives a slight indication of a transition effect.

W. J. SWIATECKI

537.591.8

5559. The generation of star-producing particles in a dense substance at a height of 25 km. Zh. S. Takibaev. *Zh. eksper. teor. Fiz.*, **23**, *No.* 5 (11) 543–51 (1952) *In Russian.*

The results of balloon flights with emulsions shielded by 0, 0·2, 0·6, 1·4, 1·8 cm Pb in specially thin containers show an increase of the number of single heavy tracks and stars with increasing shielding. Estimates show that this "transition effect" can be understood in terms of the increased number of secondary nucleons and π-mesons generated in the absorber.

W. J. SWIATECKI

537.591.8

5560. Slow $\varkappa$ mesons emitted in "cosmic [ray] stars." J. Crussard, L. Leprince-Ringuet, D. Morellet, A. Orkin-Lecourtois and J. Trembley. *C.R. Acad. Sci.* [*Paris*] **256**, 872–4 (*March* 2, 1953) *In French.*

The analysis of the scattering and ionization in emulsions for 3 such mesons gives a mass $(940 \pm 40)m_e$, which is compatible with previous observations.

W. J. SWIATECKI

MAGNETISM 538

538 : 621.3.011

5561. Towards the definition of several magnetic quantities. G. Oberdorfer. *Arch. elekt. Übertragung*, **7**, 136–42 (*March*, 1953) *In German.*

Eleven definitions relating to intensity of magnetization, magnetic induction, polarization, permeability and susceptibility are presented. These are in historical sequence and range from J. C. Maxwell to G. I. Cohn. The definitions are shown to differ not only in details but even in principles. It is then proposed to base the group of definitions on the force law $F = BIl$. The implications of this procedure and the effect on the dimensions of the units are discussed.

S. C. DUNN (R)

538.082.1 : 537.533.72 : 621.385.833 : 621.317.328

5562. A suspended system for the electrodynamic measurement of the field along the axis of a magnetic electron lens. P. Durandeau. *C.R. Acad. Sci.* [*Paris*] **236**, 366–8 (*Jan.* 26, 1953) *In French.*

The field was measured by observing the displacement of a small suspended solenoid in which a current was flowing, when the lens field was switched on. An accuracy of 0·25% is quoted.

G. D. SIMS

538.083.9

5563. Investigation of static magnetic fields by means of nuclear magnetic resonance. G. J. Béné, P. M. Denis and R. C. Extermann. *J. Phys. Radium*, **13**, 71S–2S (*Dec.*, 1952) *In French.*

Describes measurements of the magnetic field strength H of an electromagnet and of a Helmholtz coil system using the relation $\omega = \gamma H$, where ω is the resonance frequency and γ the gyromagnetic ratio.

E. P. WOHLFARTH

538.114

5564. On the theory of single domain particles. E. Kondorskiĭ. *Dokl. Akad. Nauk SSSR*, **82**, *No.* 3, 365–8 (1952) *In Russian.*

A theoretical paper based on the author's previous work on ferromagnetic powders [Abstr. 5116 (1950), 2830 (1951)]. Recent results show that single domain particles have a critical size depending on the magnetic field. Therefore an expression for the size of ellipsoidal particles in terms of the magnetic parameters is obtained, by considering a function containing the minimum free energy of the system. From this the strength of the magnetic field and the critical size of the ellipsoid, for which the particle is a single domain, are derived. Calculations for spherical particles show the dependence of the magnetic field strength on the concentration of the particles.

W. BARDSLEY

538.22

5565. The magnetic properties of some anhydrous chlorides. N. Elliott. *J. chem. Phys.*, **21**, 890–1 (*May*, 1953).

The magnetic susceptibility of $CoCl_2$ and of solid solutions of $CoCl_2$ with $ZnCl_2$ and $CdCl_2$ have been measured over the temperature range 76°–296°K. The susceptibility of $CoCl_2$ is very little affected by dilution with isomorphous chlorides. The results are interpreted as showing that $CoCl_2$ deviates from Curie's law in its behaviour because of a crystalline-field Stark effect rather than Heisenberg spin-spin exchange.

A.

538.221

5566. Investigation of ferromagnetic resonance in Cr–Te alloys [50 mol. % Te]. T. M. Perekalina. *Dokl. Akad. Nauk SSSR*, **84**, *No.* 3, 475–6 (1952) *In Russian.*

Birks's method [Abstr. 1272 (1948)], in which a frequency field (10, 5·0, and 3·14 cm waves) was applied at right angles to a constant magnetic field, was used to measure the magnetic permeabilities μ' and μ''. No maxima or minima were observed with 10 cm waves; two maxima were obtained with 5 cm waves, the first ascribed to spin, and the second, at 7500 oersted, to orbital, resonance. With 3·14 cm

waves only the first spin resonance could be observed, but it is thought that a second max. would be observed at 12 000–13 000 oersted (the max. field used was 9000 oersted). The *g*-factor for the first max., calculated from the results, is 2·10–2·20, and for the second max. is ~0·6. R. C. MURRAY

538.221

5567. Ferromagnetic resonance in parallel wires. V. K. ARKAD'EV AND A. G. KOTOV. *Dokl. Akad. Nauk SSSR*, **83**, *No.* 6, 821–4 (1952) *In Russian.*

The absorption of 2·5–25 cm waves in 2 fine parallel wires of Ni or Fe, passing through a solenoid which could exert a magnetic field of up to 1400 oersted, was measured by connecting a thermocouple across them at various distances from the radiation source (spark or clystron) and noting the reading on the galvanometer to which the couple was connected. The greatest "induced" magnetic resonance (max. absorption of the e.m.f. waves at a certain field strength) occurs with waves of 3–6 cm, which Arkad'ev found (in 1912) to be those which suffer max. absorption because of natural resonance (no magnetizing field), of the elementary magnets. The method can be adapted for studying the effects of various other physical and chemical stresses on wave absorption and magnetic resonance. R. C. MURRAY

538.222

5568. Paramagnetic resonance absorption in metals. S. A. AL'TSHULER, V. YA. KURENEV AND S. G. SALIKHOV. *Dokl. Akad. Nauk SSSR*, **84**, *No.* 4, 677–9 (1952) *In Russian.*

Values of relative losses at $2{\cdot}38\times10^8$ c/s and static fields up to 1000 oersted show resonance absorption with, respectively, maximum absorption and half widths at half height (i.e. $H_{\frac{1}{2}}-H_{max}$ with $H_{\frac{1}{2}}>H_{max}$) of 76 and 265 oersted for Ti, 76 and 270 for V, 90 and 210 for Cr, 90 and 235 for Mn, 100 and 245 for Nb, 90 and 140 for La, 67 and 150 for Ce and 60 and 150 for W. Na, Mg, Al, Cu, Zn, As, Se, Ag, Cd, Sn, Hg and Bi show no effect. $g\sim2$ within 30%, indicating free spins and essentially quenched orbital moments. D. H. WHIFFEN

538.222

5569. Paramagnetic resonance absorption in a single crystal of gadolinium nitrate. N. S. GARIF'YANOV. *Dokl. Akad. Nauk SSSR*, **84**, *No.* 5, 923–5 (1952) *In Russian.*

Resonance at $9{\cdot}378\times10^9$ c/s and static fields up to 6000 oersted for a single crystal of $Gd(NO_3)_36H_2O$ diluted with ten parts of $La(NO_3)_36H_2O$ has the shape and fine structure predicted for a cubic crystalline field with $\delta=0{\cdot}176$ cm^{-1} to the first approximation only. A diagram of loss *v.* field strength is given for the (001), (111) and (110) orientations. D. H. WHIFFEN

538.222

5570. Paramagnetic dispersion. A. AKHIEZER AND I. POMERANCHUK. *Dokl. Akad. Nauk SSSR*, **87**, *No.* 6, 917–18 (1952) *In Russian.*

A theoretical discussion of paramagnetic relaxation frequencies at low temperatures. D. H. WHIFFEN

538.222

5571. Paramagnetic electron resonance. History and principal results. J. UEBERSFELD AND J. COMBRISSON. *J. Phys. Radium*, **14**, 104–10 (*Feb.*, 1953) *In French.*

538.24

5572. Some new relationships between loss value and coercive force. N. S. AKULOV AND T. A. ELKINA. *Dokl. Akad. Nauk SSSR*, **83**, *No.* 3, 377–9 (1952) *In Russian.*

538.24

5573. Magnetization of heterogeneous materials in strong fields. K. M. BOL'SHOVA. *Zh. eksper. teor. Fiz.*, **23**, *No.* 3 (9) 349–56 (1952) *In Russian.*

The law of approach to saturation of the permeability of homogeneous materials may be represented by the empirical relation $\kappa=AH^{-2}+BH^{-3}+CH^{-4}+\kappa_p$ where κ is the differential permeability, H the magnetic field strength, A, B, C being constants and κ_p is the permeability of the paraprocess. Measurements on Fe–Mo alloys showed that the term AH^{-2} becomes conspicuous here only when the solubility limit is exceeded, i.e. when non-magnetic inclusions appear in the structure of the alloy. The influence of these inclusions on magnetic hardness and coercive force is different, since the latter is influenced by the particle size of the inclusions, which does not hold for the magnetic hardness. If constancy of the volume of all the inclusions is assumed, the magnetic hardness will not vary if the volume is redistributed over the inclusions. Whereas the coercive force for very small grain size of the inclusions may be ~several 100 oersted, it is of the order of units for large inclusions. The predominant term will thus become AH^{-2} already for fields of ~1000 oersted, and not BH^{-3} as for homogeneous materials. Also, the constant B is always positive for homogeneous materials, negative for inhomogeneous materials in which the inclusions are appreciable at all. The range of validity of the law of approach to saturation is wider for inhomogeneous than for homogeneous materials. Qualitatively these relationships agree with Neel's theory. B. F. KRAUS

538.24 : 539.374

5574. The magnetization curve for plastic deformed iron in strong fields. N. S. AKULOV AND K. M. BOL'SHOVA. *Dokl. Akad. Nauk SSSR*, **83**, *No.* 6, 817–19 (1952) *In Russian.*

The differential permeability χ for annealed Armco iron and Fe containing 4% of Mo gives a linear plot against $1/H^3$, which practically coincides with the plot for the same materials after 10, 20 or even 30% reduction by rolling. The explanation advanced for this marked difference from the behaviour of Ni is that, according to Akulov and Kirenskii's theory (1939), the proportionality constant B in the formula $\chi=(B/H^3)+\chi_r$ can be split into 2 terms, one depending on the energy anisotropy, and the other on the magneto-elastic energy, and for Ni at rupture the latter is 100 times the former, whereas for Fe at rupture it is only 1/7th of it, so that χ for Fe is little affected by mechanical stress, but strongly affected by it for Ni. Mechanical stress affects the magnetic behaviour of a material more strongly, the higher the ratio of the magnetostriction to the anisotropy constant. R. C. MURRAY

538.245

5575. Magnetic viscosity of nickel-zinc ferrites. E. F. KURITSYNA. *Dokl. Akad. Nauk SSSR*, **84**, *No.* 1, 45–6 (1952) *In Russian.*

One ferrite having a permeability μ_0 of 1600 showed superviscosity at 80°K (with a relaxation time τ of $\sim$4 sec) but none at 293°K, and two other samples with μ_0 values of 600 and 650 showed none at 80, 195 or 293°K. Whereas all other known materials have only one max. magnetic viscosity, which is on the steeply rising part of the hysteresis loop, all these ferrites have a minimum τ in this region, and two maxima, one on the upper, and the other on the lower, bend of the hysteresis loop. These materials do not obey Telesnin's first rule of magnetic viscosity [Abstr. 3643 (1951)], but they do follow the second, that the value of τ should be dependent only on the final magnetic state. R. C. MURRAY

538.245

5576. Effect of a demagnetizing field on magnetic viscosity. R. V. TELESNIN AND E. F. KURITSYNA. *Dokl. Akad. Nauk SSSR*, **84**, *No.* 3, 477–8 (1952) *In Russian.*

It is shown that the effect of a demagnetizing field on the magnetic viscosity can be easily obtained by calculating the time of relaxation τ, from the formula $\tau = A\chi_d/T$ where χ_d = magnetic susceptibility and T = absolute temperature. Measurements of τ by the methods previously described [Abstr. 1496 (1949)] on cylindrical wires of iron carbonyl, 1 mm long, and with a relative length of 52–360, agree well with those calculated from the formula. This indicates that the magnetic viscosity is a function of the body and not the substance, and that viscosity curves should be plotted as functions of the external and not of the internal field. R. C. MURRAY

538.245

5577. Temperature dependence of the magnetic viscosity of ferro-nickel alloys. E. F. KURITSYNA. *Dokl. Akad. Nauk SSSR*, **84**, *No.* 4, 687–8 (1952) *In Russian.*

The relaxation time τ of Hypernic (50% Ni) and Permalloy (78·5% Ni) when the magnetic field is changed by 0·5 oersted is substantially unchanged when the temperature varies from 80°K to 6730°K, whereas that of Invar (35% Ni) increases considerably within this range. For all alloys, the value of A in the equation $\tau = A\chi_d/T$, where χ_d is the differential magnetic susceptibility and T is the absolute temperature, increases very considerably with temperature, in contradiction of Telesnin's [Abstr. 3643 (1951)] first rule for magnetic viscosity. The second rule, that τ is only determined by the final magnetic state of the material, was found to hold for Invar. R. C. MURRAY

ELECTROMAGNETISM . ELECTRODYNAMICS 538.3/.5

538.3 : 621.3.01

5578. The spirit of geometry in electromagnetism and in electrical engineering. L. SARTRE. *Bull. Soc. Franc. Elect.* (*Sér.* 7) **3**, 105–15 (*March*, 1953) *In French.*

An expository paper covering network theory, minimal theorems in statics and dynamics, and the principle of least action in electrical engineering. A geometrical viewpoint is emphasized in the development of the appropriate algebra or analysis. L. S. GODDARD (R)

538.5

5579. Some vector formulae and examples of their application. H. L. KNUDSEN. *Fysisk T.*, *No.* 3–4, 101–12; *No.* 5–6, 163–75 (1952) *In Danish.*

Series of vector formulae based on (*a*) Gauss's theorem, (*b*) Stokes's theorem, and (*c*) a line integral over a closed loop are derived and illustrated in problems in (*a*) electric, (*b*) magnetic polarization and (*c*) the field due to a current loop. W. J. SWIATECKI

538.5 : 539.172.4 : 621.34 : 621.318.3

5580. Direct-current electromagnetic pumps. A. H. BARNES. *Nucleonics*, **11**, 16–21 (*Jan.*, 1953).

The principle of the operation of the d.c. electromagnetic pump for transferring liquid metals is described. Expressions, relating the pumping pressure, flow rate, efficiency and the various electric, magnetic and geometric parameters are derived. These are illustrated by results obtained with the pump employed to circulate the NaK coolant through the primary circuit of the Idaho Experimental Breeder Reactor. Important features of the construction of d.c. pumps, methods of obtaining the necessarily high electric currents and the correct magnetic field distribution across the moving liquid metal, are discussed with particular reference to the E.B.R. pump. L. R. SHEPHERD

ELECTROMAGNETIC WAVES AND OSCILLATORS 538.56

538.565 : 621.396.611.21 : 621.317.335.3 : 621.396.611.4

5581. On the determination of dielectric constants of optically uniaxial crystals from the characteristic spectrum of circular cylindrical cavity resonators. E. HAFNER. *Arch. elekt. Übertragung*, **7**, 181–90 (*April*, 1953) *In German.*

See also Abstr. 2559 (1953), and following abstract. Following the previous work the distribution of field within a resonator containing a flat disk of the crystalline material is discussed. Numerous sketches portray electric and magnetic modes. It is shown that there are a number of possible ways of determining both chief dielectric constants of the material, using these field configurations. For a typical mode, curves are given of the reciprocal of the dielectric constant as a function of cavity length for a fixed operating frequency. S. C. DUNN (R)

538.565 : 621.396.611.4

5582. The complete system of electromagnetic resonances of uniaxial anisotropic crystal-loaded cavity resonators. E. HAFNER. *Arch. elekt. Übertragung*, **7**, 47–56 (*Jan.*, 1953) *In German.*

See also Abstr. 2559 (1953). A cavity resonator in the form of a straight cylinder is supposed to be occupied by an anisotropic uniaxial medium so oriented that the axis of the rotation-symmetric index

ellipsoid coincides with the axis of the cylinder. Starting from Maxwell's equations, the electric and magnetic modes are derived and their comprehensiveness established. The particular examples of the circular cylinder and parallelepiped are worked out in detail. It is intended to apply this characteristic spectrum of resonances to the estimation of the permittivities of crystals. S. C. DUNN (R)

538.566 : 532.51 : 534.22

Longitudinal magneto-hydrodynamic waves. *See Abstr.* 5339

538.566 : 535.568.1 : 621.392.26 : 621.396.611.1

5583. First results of a polarimetric study, with microwaves, of asymmetric metal resonators. R. SERVANT AND P. LOUDETTE. *J. Phys. Radium*, **14**, 79S–80S (*Jan.*, 1953) *In French.*

Some experimental results on the "microwave Cotton effect" [Abstr. 3651 (1951)] observed when a helix is placed on the axis of a waveguide. Such effect is to be expected any time there is an asymmetry in a resonator. L. PINCHERLE

538.566 : 621.392.26

5584. Propagation of electromagnetic waves along an infinite spiral crack. S. A. VAKIN. *Dokl. Akad. Nauk SSSR*, **84**, *No.* 1, 37–40 (1952) *In Russian.*

Calculations are made of the wave frequency and the geometric parameters for an infinite spiral crack around an infinite cylinder with thin ideal conducting walls, immersed in a homogeneous isotropic medium, along which crack an e.m. wave is propagated without damping. This is done by finding, from an assumed law for the distribution of potential along the wave, the field inside and outside the cylinder, and by using the continuity of the tangential component of the magnetic vector on passing through the surface of the crack, to form the transcendental equation for determining the propagation constant in the potential distribution equation. Theoretical and experimental results are plotted for very narrow spiral cracks of 7, 8·5, 12 and 17° pitch, as k/k_n against r_0k, where k, k_n are the propagation rates in the crack and *in vacuo*, respectively, and r_0 is the cylinder radius. The calculated damping regions are slightly less in extent than those found experimentally, while experiment confirms the theoretical prediction that there is no deceleration along a crack ($k/k_n \simeq 1$) in contrast to the positive deceleration of propagation along a spiral wire. R. C. MURRAY

538.566 : 621.392.26

5585. Theory of a waveguide with a spiral (conductor), partially filled with a dielectric. V. P. SHESTOPALOV. *Zh. tekh. Fiz*, **22**, *No.* 3, 414–25 (1952) *In Russian.*

After surveying briefly various designs of waveguides intended to reduce phase velocity below that of light and thereby obtain higher efficiency, a concise mathematical treatment of a cylindrical waveguide with an outer concentric dielectric layer and a central spiral is given. Maxwell's equations are solved and interpreted physically. The dispersion formula is derived next and solved for two boundary cases, enabling the travelling electromagnetic field energy to be calculated. The results show that, although involving considerable losses in the dielectric when in operation, this particular waveguide construction achieves a considerable reduction of phase velocity, avoids build-up of charges on the dielectric surface, does not possess a critical wavelength, is not critical in the choice of cross-sectional dimensions and does not distort the applied signal unduly. A. LANDMAN (R)

538.566 : 621.392.26

5586. Propagation of microwaves through a cylindrical metallic guide filled coaxially with two different dielectrics. S. K. CHATTERJEE. *J. Indian Inst. Sci. B*, **35**, 1–16 (*Jan.*, 1953).

The field components for the TE_{01} mode in a cylindrical metallic guide completely filled with two different dielectrics have been derived from Maxwell's equations. The attenuation constant for this mode has been calculated with the help of the Poynting vector and the field components. A.

538.566 : 621.396.671

5587. Astigmatic diffraction effects in microwave lenses. A. S. DUNBAR. *Trans Inst. Radio Engrs Prof. Group on Antennas and Propagation*, *No.* 4, 72–80 (*Dec.*, 1952).

A theoretical discussion of astigmatism is given, leading to an integral evaluated by Steward (1926) and the reduction in gain due to astigmatism is computed. Experimental results on a dielectric lens with 8·6 mm radiation support the theory. A. H. W. BECK

538.566 : 621.396.677

5588. On spherically symmetric lenses. J. E. EATON. *Trans Inst. Radio Engrs Prof. Group on Antennas and Propagation*, *No.* 4, 66–71 (*Dec.*, 1952).

Considers a lens with continuously variable refractive index which images a sphere into another sphere. This lens is due to R. K. Luneberg. An integral equation is set up which, in general, involves untabulated functions. Some limiting cases, useful in microwave aerials, can be solved. A. H. W. BECK

538.566.2 : 621.396.11 : 621.396.812

5589. Multiple bursts of signal in long-distance very-high-frequency propagation. G. A. ISTED. Letter in *Nature* [*London*] **171**, 617–18 (*April* 4, 1953).

Field strength records of c.w. transmissions in the frequency band 40–60 Mc/s over a distance of 330 miles exhibit multiple bursts of signal intensity which appear to follow upon lightning flashes. It is suggested that this phenomenon is related to the "whistler" type atmospheric. W. J. G. BEYNON

538.566.2 : 530.145.6 : 621.396.11

5590. The analogy between certain aspects of tropospheric propagation and particle trajectories in wave mechanics. M. ORTUSI. *Ann. Radioélect.*, **8**, 81–95 (*Jan.*, 1953) *In French.*

In Part I a critical discussion is given of the classical theory of tropospheric propagation, and in Part II the correspondence between the theory of such propagation and that of particle-waves is considered. An application of the analogy in the theory of semiconductors is also briefly noted. W. J. G. BEYNON (R)

538.566.2 : 621.396.11

5591. Reflection of centimeter radio waves from ground and water surfaces. A. W. STRAITON. *Texas J. Sci.*, **5**, 76–84 (*March*, 1953).

Reflection coefficients for wavelengths between 26·5 cm and 8·6 mm were measured over constant

path lengths from the envelopes of maxima and minima of the height-gain curves for given aerial characteristics and surface roughness. Over land (sparse matting of grass stalks) the reflection coeff. increased with wavelength, approaching the theoretical curve for $\lambda 26{\cdot}5$ cm, and for the longest wavelengths approached unity as the grazing angle approached zero. The surface appeared smoooth at 26·5 cm and rough at 8·6 mm. Over water, the longer waves showed specular reflection characteristics even for the roughest conditions, while the 8·6 mm waves were effected by even small winds. G. M. BROWN

538.566.2 : 551.501.8 : 621.396.11 : 621.396.91

5592. Report of factual data from the Canterbury project. A radio-meteorological investigation in the South Island of New Zealand. Vol. I. Description and numerical data. *Wellington, New Zealand: Department of Scientific and Industrial Research* (1951) 858 *pp.*

Contains a detailed account of the meteorological and radio equipment and their operation, the site of the experiments, the weather in Canterbury in a westerly direction, and the presentation and evolution of observational data. A very large amount of information is tabulated, to permit immediate theoretical and statistical analysis.

538.566.2 : 621.396.11

5593. Gradient reflections from the atmosphere. J. FEINSTEIN. *Trans Inst. Radio Engrs Prof. Group on Antennas and Propagation, No.* 4, 2–13 (*Dec.*, 1952).

Study of the effects of atmospheric refractive index gradients on the solution of the wave equation for partial reflection. If the index gradient function is continuous, with derivatives of all order continuous at all points above the earth, it is shown that the effect on the field far beyond the horizon is of the order of, and probably equal to, the effective earth radius correction of the uniform atmosphere theory. When a discontinuity in any order derivative is present, it is found that the magnitude of the power is a function of the order of the derivative possessing the discontinuity. An attempt is also made to investigate the case of specular reflection from random gradients of refractive index assuming complete horizontal stratification. G. M. BROWN (R)

538.566.3

5594. Electromagnetic phenomena in the ionosphere: crossed effects of a constant magnetic field and oscillating electric field. R. JANCEL AND T. KAHAN. *C.R. Acad. Sci.* [*Paris*] **236,** 788–90 (*Feb.* 23, 1953) *In French.*

Mathematical note employing the Boltzmann equations to develop expressions for the distribution function of the speeds of free electrons in an ionized gas under the conditions specified. The result reduces to that given by Chapman and Cowling when the electric field is constant, and to that of Margenau and Druyvesteyn when the magnetic field is zero.

G. M. BROWN

538.566.3 : 621.396.11

5595. A problem of radio-goniometry: ionospheric anisotropy. G. ELGHOZI. *Ann. Télécomm.*, **8,** 78–92 (*March*, 1953) *In French.*

Following a discussion of the magneto-ionic theory of Appleton, the theories of both Booker and Alpert are examined in detail. Both these authors give formulae for the lateral deviation of electromagnetic waves expected on the magneto-ionic theory, which employ equivalent methods of calculation. These formulae are compared, and it is pointed out that the practical differences of the results are due to differences of the various parameters (frequency, distance, inclination of magnetic field, etc.) entering the formulae. Some simple cases are treated which give the order of magnitude of the lateral deviations calculated by Booker's method. G. M. BROWN

538.566.3 : 621.396.11

5596. The ionospheric penetration frequency at oblique incidence. H. POEVERLEIN. *Z. angew. Phys.*, **5,** *No.* 1, 15–19 (1953) *In German.*

The usual methods for the calculation of ray paths in the ionosphere, in which the influence of the earth's magnetic field is considered, are applied to study the penetration frequency at oblique incidence. Results are exhibited graphically showing the ratio of the penetration frequency with and without the magnetic field and its dependence on angle of incidence. W. J. G. BEYNON (R)

MAGNETIC EFFECTS 538.6

538.613

5597. Determination of the magneto-optical constants of phosphite ions. D. VOIGT. *C.R. Acad. Sci.* [*Paris*] **236,** 1028–30 (*March* 9, 1953) *In French.*

The molecular rotations of solutions of Na_2HPO_3, Li_2HPO_3, NaH_2PO_3 and LiH_2PO_3 of various concentrations have been determined using the mercury line $\lambda 5780$ Å. Assuming the magneto-optical contributions of the cations, the ionic rotatory constants of $H_2PO_3^-$ and $HPO_3^=$ are calculated and found to be rather higher than the molecular constant of the acid H_3PO_3. G. I. W. LLEWELYN

538.613 : 537.311

5598. The Faraday effect in conductors and semiconductors. A. SURDUTS. *C.R. Acad. Sci.* [*Paris*] **236,** 1005–7 (*March* 9, 1953) *In French.*

A re-examination of the fundamental equations of the effect showing that measurements should be practicable for fairly low magnetic fields (~ 5000 oersted). C. A. HOGARTH

538.632

5599. Hall effect and temperature in ferromagnetic conductors. J.-P. JAN. *Helv. phys. Acta*, **25,** *No.* 7, 677–700 (1953) *In French.*

The Hall effect is considered as a particular case of Meixner's phenomenological relations between the electrical and thermal currents, the electrical field and the temperature gradient. These equations make it possible to work out a theory of measurement, indicating that experiments, under certain restrictions, generally give the isothermal Hall effect, and this even if conditions are adiabatic. In the case of ferromagnetics, the Hall effect is the sum of two terms:

the field effect and the magnetization effect; this makes necessary the introduction of two Hall constants. The magnetization Hall effect is the mean value of the spontaneous effects; more detailed calculations of the mechanism of orientation show what conditions have to be fulfilled if the latter is to be proportional to the observable magnetization. A number of errors has been studied: finite length of the samples, position of the probes, obliquity of the sample in the magnetic field, and the influence of the sample on the latter. Theory (Perrier) shows that knowledge of the Hall effect necessitates the determination of two parameters; in the experiments, the Hall voltage and the resistivity were determined on the same specimens. This allows the calculation of the ordinary parameter (Hall resistivity), the angle of galvanomagnetic anisotropy and the transversal galvanomagnetic conductivity. The variation with temperatures in the range of −190° to +600°C has been studied in iron and nickel. The magnetization Hall constant depends mostly on purity. For the same metal, it increases with resistivity. [See also Abstr. 7435 (1952)]. A.

538.632

5600. Investigation on the temperature dependence of the Hall effect in electrolytic iron. V. V. Parfenov and V. R. Abel's. *Dokl. Akad. Nauk SSSR*, **82**, *No.* 6, 877–9 (1952) *In Russian.*

It has been found that, in the temperature interval 77–1053°K, (1) the Hall potential difference E is proportional to the resultant magnetization of the specimen, while (2) this difference attains a maximum near the Curie point, to fall off rapidly with the further temperature increase; finally, (3) the increment of the Kikoin's constant R_f for ferromagnetics [*Sovetskaya Fizika*, **9**, 1 (1936)] is proportional to the difference of squares of the saturation magnetization of the specimen at the two temperatures involved.

F. LACHMAN

538.632

5601. The Hall–Kikoin effect as an indicator of the structure of high speed steel. N. M. Genkin and G. P. Priporova. *Zh. eksper. teor. Fiz.*, **23**, *No.* 4 (10) 477–80 (1952) *In Russian.*

Discusses the dependence of the Hall–Kikoin e.m.f. [Abstr. 2383 (1936)] on the percentage ratio of residual austenite in the steel. Experiments show a decrease in the e.m.f. proportional to an increase in the residual austenite. [See also Abstr. 6369 (1951).]

W. BARDSLEY

538.652

5602. Generalization of the law of approach to saturation of even effects. G. P. D'yakov. *Dokl. Akad. Nauk SSSR*, **82**, *No.* 6, 867–8 (1952) *In Russian.*

The expression for the increase of magnetostriction with an increase of the strength of magnetic field, previously stated for (1) isotropic ferromagnetic specimens in the absence of internal elastic stresses [Abstr. 3295 (1950) and *Vestnik. Moskovsk. Univ.*, *No.* 9, 43 (1949)], (2) slightly anisotropic specimens in the presence of diffuse stresses [*Vestnik. Moskovsk. Univ.*, *No.* 6, 45 (1951)], and (3) specimens subjected to homogeneous elastic stresses (to the first degree of approximation only) [Abstr. 3674 (1951) and *Vestnik. Moskovsk. Univ.*, *No.* 5, 31 (1951)] is now extended to take into account (*a*) diffuse stresses in highly anisotropic bodies and (*b*) homogeneous elastic stresses to a higher degree of approximation. Magnetostriction is found to be a function of the square of diffuse stresses and of the first degree and square of homogeneous elastic stresses. Equations derived permit the determination of mean diffuse and elastic stresses. A. GELBTUCH

538.652

5603. Theory of magnetostriction and of the other even effects in strong magnetic fields. G. P. D'yakov. *Zh. eksper. teor. Fiz.*, **23**, *No.* 5 (11) 525–31 (1952) *In Russian.*

A theory is given for polycrystalline ferromagnetic materials. Formulae for the calculation of the even effects in materials without texture are also derived. The relationships obtained are extended to the case of elastically stressed materials, two limiting cases being analysed, viz. those of stresses of diffuse character, and uniform stresses coinciding with the magnetic field direction. The considerations are based on Akulov's calculation of the magnetostriction of a monocrystal in saturation conditions experimentally confirmed for nickel. The co-ordinates of the position of the spontaneous magnetization vector of the crystal are found from the minimum condition of the total energy. Interaction between crystallites may be neglected for polycrystalline media. The law of approximation to saturation of the even effects interrelates all the important characteristics of a ferromagnetic which may be found from magnetostriction measurements. In the case of diffuse stresses, the magnetostriction is inversely proportional to the square of these stresses. B. F. KRAUS

538.66

5604. Thermomagnetic effect of the alloy Fe_3Pt. R. G. Annaev and M. V. Kolodin. *Dokl. Akad. Nauk SSSR*, **82**, *No.* 5, 697–700 (1952) *In Russian.*

It has been determined experimentally that (1) the decrease of the annealing temperature of the Fe_3Pt sample brings about not only a decrease of the absolute magnitude of the thermomagnetic effect, but that the latter changes its sign, passing from the negative into the positive region; (2) the magnetization decreases together with the temperature of annealing; (3) Akulov's [Abstr. 5594 (1949)] law of anisotropy of even effects is confirmed for this alloy near the Fe_3Pt composition. F. LACHMAN

538.69 : 536.42

5605. Influence of magnetic field on polymorphic transformations in ferromagnetic substances. A. J. P. Meyer and P. Taglang. *J. Phys. Radium*, **14**, 82–4 (*Feb.*, 1953) *In French.*

Shows that under certain conditions the change of the transformation temperature, $\Delta\theta$, due to application of a magnetic field of strength ΔH is given by $\Delta\theta/\theta = \sigma\Delta H/L$, where σ is the spontaneous magnetization and L the latent heat. This relation is verified for the polymorphic transformation in MnAs at about 40°C, using experimental data due to Guillaud.

E. P. WOHLFARTH

MOLECULAR AND ATOMIC STRUCTURE 539.1

THEORY OF SOLID STATE 539.11

539.11 : 535.343–12/14

5606. Hertzian spectrum and the structure of solids. I. Debye absorption of solids in the Hertzian spectrum and lattice defects. M. FREYMANN AND R. FREYMANN. *J. Phys. Radium*, **14**, 203–11 (*March*, 1953) *In French.*

A wide introductory review with a special section on lattice defects. D. H. WHIFFEN

539.11 : 538.221 : 536.631

5607. The effect of atomic vibrations on the paramagnetism and specific heat [of ferromagnetic metals]. T. G. OWE BERG. *J. Phys. Radium*, **14**, 100–3 (*Feb.*, 1953) *In French.*

Suggests a mechanism of resonance between thermal atomic vibrations and the oscillations of the interaction energy between states of parallel and antiparallel spin for ferromagnetic substances in the neighbourhood of the Curie point. Application is made to an interpretation of the λ-point of the specific heat curve and to the temperature variation of the paramagnetic susceptibility. E. P. WOHLFARTH

539.11 : 539.4.016

5608. Isothermal annealing effects in irradiated copper. A. W. OVERHAUSER. *Phys. Rev.*, **90**, 393–400 (*May* 1, 1953).

Copper wires were bombarded with 12 MeV deuterons at low temperatures. The wires were then allowed to anneal isothermally at successive temperatures from −185°C to +167°C. Recovery of the electrical resistivity increase, produced by the bombardment, was observed at all temperatures. The annealing curves obtained for temperatures between −185°C and −60°C were of such a character that only a number of processes with different activation energies could account for them. One-half of the resistivity increase recovered in this range. The activation energies obtained were observed to be proportional to the absolute temperature. A value of 0·44 eV was found near −100°C. Above −60°C the annealing behaved as though it were a single process with a unique activation energy. This process accounted for 25% of the increased resistivity and had an energy of 0·68 eV. At room temperature 25% of the increase remained, and further anneals to temperatures as high as 167°C produced only an additional 4% recovery. Detailed analysis of the data suggests that the single process occurring above −60°C is the result of the annihilation of interstitial atoms and vacancies that are produced by the irradiation. Slight deviations of the recovery rate from that expected of such a second-order process were observed and could be explained as the effect of elastic strains introduced into the lattice by interstitial atoms. The effect of such lattice strains on the rate of vacancy migration was calculated and found to have sufficient magnitude to explain the data. The results also suggested that the low temperature recovery is due to the correlated annihilation of very close interstitial vacancy pairs, the low activation energies being due to large elastic strains in the immediate vicinity of an interstitial. A further result, which can be derived from the activation energy for self-duffusion in copper, is that the energy of formation of a vacancy is 1·39 eV. A.

MOLECULAR STRUCTURE 539.13

539.13

5609. Quantum mechanical treatment of the interaction of a polar molecule with an atom. N. D. SOKOLOV. *Zh. eksper. teor. Fiz.*, **23**, *No.* 3 (9) 315–26 (1952) *In Russian.*

Using the electron-pair method, an approximate solution is given for the interaction of a polar diatomic molecule with an atom whose outer electron shell is filled. The result is applied to the hydrogen bond, as in RO–H . . . OR_1. J. JACOBS

539.13

5610. On the question of energy exchange between translational motion and molecular vibration and rotation. I. A. E. GLAUBERMAN. *Zh. eksper. teor. Fiz.*, **23**, *No.* 2 (8) 182–7 (1952) *In Russian.*

The energy exchange between the vibrations of a diatomic molecule during an arbitrary collision with an impinging atom is investigated. A scheme for successive quantum mechanical solutions is given. Earlier workers restricted themselves to application of excitation theory to the last order, whereas 2nd-order terms need to be retained. J. JACOBS

539.13

5611. On the question of energy exchange between translational motion and molecular vibration and rotation. II. A. E. GLAUBERMAN AND V. I. DOROGAN'. *Zh. eksper. teor. Fiz.*, **23**, *No.* 4 (10) 430–9 (1952) *In Russian.*

Vibrational transition probabilities for diatomic molecules during collision with an atom are determined, and compared with experimental data, using Cl molecules. These probabilities are sensitive to variations in a, the coeff. of the exponential function. For excitation of molecular vibrational states, atoms with energy $1\cdot4$–$1\cdot6\hbar\omega$ are important. Second-order approximations lead to insignificant corrections; agreement with experiment is good. J. JACOBS

539.13

5612. Collisional excitation of F_2O. H. AROESTE. *J. chem. Phys.*, **21**, 870–5 (*May*, 1953).

The quantum mechanics is applied to the calculation of the intrinsic probability of excitation of vibration and rotation of an idealized F_2O molecule by a neon atom. Comparisons are made of the excitation of the three normal vibrations from the zeroth to the first states. The probabilities of excitation of rotation accompanying vibrational excitation are explicitly shown and discussed. Further, excitations involving a change of two and four vibrational quantum numbers are approximated. A.

539.13

5613. Photoelectric observation of the rate of recombination of iodine atoms. R. MARSHALL AND N. DAVIDSON. *J. chem. Phys.*, **21**, 659–64 (*April*, 1953).

The rate of the homogeneous three-body recombina-

tion of iodine atoms, $I + I + M \rightarrow I_2 + M$, $d[I_2]/dt = k[I]^2[M]$, is measured. A short intense pulse of light from a flash lamp dissociates 1–9% of the *c.* 10^{18} iodine molecules in a 200 cm^3 cell, and the subsequent recombination of iodine atoms is followed by fast photoelectric techniques. The measured values of k at room temperature are $4{\cdot}2(\pm 0{\cdot}4)\times 10^9$ litre^2 moles^{-2} sec^{-1} (argon), $58(\pm 4)\times 10^9$ (neopentane), $65(\pm 6)\times 10^9$ (pentane). The value for neopentane is the same at 200°C. The large values of the recombination rate constants indicate that an important recombining process consists of a "sticky" collision between an I atom and an M molecule or atom, leading to the formation of a complex IM, which reacts with a second I atom. The lifetimes of the collision complexes are estimated. The rates of the reverse process, the dissociation of I_2 by collision with M, are calculated; the pre-exponential factors are extraordinarily large. The extinction coefficients of gaseous-iodine have been remeasured. A.

539.13

5614. Studies in energy transfer. I. The combination of iodine atoms. K. E. Russell and J. Simons. *Proc. Roy. Soc. A*, **217**, 271–9 (*April* 8, 1953).

An experimental study has been made of the velocity of combination of iodine atoms in the presence of a number of added gases in order to investigate the factors influencing energy transfer. The reaction cell, containing iodine at a pressure of 0·097 mm Hg and a known pressure of third body, is irradiated with a flash from a discharge tube. The concentration of iodine atoms as recombination proceeds is determined by measuring the light absorption of the system with a photomultiplier tube. The reaction is second order with respect to the concentration of iodine atoms, and first order with respect to the third body. The third-order rate constants vary from $0{\cdot}97\times 10^{-32}$ mol^{-2}. cm^6. sec^{-1} when helium is added to 224×10^{-32} mol^{-2}. cm^6. sec^{-1} for mesitylene. The velocity of combination at 127°C has been found to be approximately 0·4 times the velocity at 20°C for six different additives. This factor seems to be independent of the nature of the additive. The efficiencies of the different additives is primarily determined by the magnitudes of their intermolecular force fields, which are reflected in their boiling-points and critical temperatures. A.

539.13

5615. Note on the rate of recombination of free atoms. G. Careri. Letter in *J. chem. Phys.*, **21**, 749–50 (*April*, 1953).

The recombination rate of two free atoms can be calculated by two methods: the direct impact of the atoms with a third body, or the reverse dissociation process can be considered. The latter method can be applied in two ways [Rice, *J. chem. Phys.*, **9**, 258 (1941), and Careri, *Nuovo Cimento*, **7**, 155 (1950)]: the dissociation rate constant can be derived from the collision theory with the inclusion of excited rotational states, comparable in energy with vibrationally excited states, and all probabilities should be added with their statistical weights. Rice's method assumes that only ordinary thermal collisions of vibrationally highly excited molecules cause dissociation. For the dissociation of H_2 this results in a too low rate constant, whilst the author's result is of the same order as the experimental value. A. J. TAYLOR

539.13

5616. Reply to Careri's "Note on the rate of recombination of free atoms." O. K. Rice. Letter in *J. chem. Phys.*, **21**, 750–1 (*April*, 1953).

See preceding abstract. It is pointed out that the number of effective collisions as calculated by Careri has no direct connection with the actual number. The effective diameter calculated with his equation is much too large. The effect of rotation, however, may be taken into account, as indicated by Careri. This should make an appreciable difference to the results for the H_2 dissociation. A. J. TAYLOR

539.13

5617. An approximate calculation of the benzene self-complex interaction energy at high pressure. K. E. Shuler. Letter in *J. chem. Phys.*, **21**, 765–6 (*April*, 1953).

The approximate formula $2\varepsilon = 2{\cdot}86\times 10^8\Delta\lambda/(\lambda_A)^2$ [2ε = interaction energy, and $\Delta\lambda$ = shift of the main absorption peak at high pressure], derived from a previous paper [Abstr. 1802 (1953)], yields, when applied to C_6H_6 an average interaction energy of ~200 cal/mole. F. LACHMAN

539.13 : 530.162

On the spectra of systems of interacting particles. *See Abstr.* 5309

539.13 : 533.7

5618. Intermolecular force constants from thermal diffusion and other properties of gases. B. N. Srivastava and M. P. Madan. *J. chem. Phys.*, **21**, 807–15 (*May*, 1953).

The thermal diffusion data on argon have been examined on the basis of the Lennard–Jones 12 : 6 model by reducing the experimental data through a more appropriate variation of R_T with temperature than has been done hitherto. The value of the force constant ε, thus determined from the observed variation of R_T with temperature, is found to increase slightly with temperature. This variation of ε shows the inadequacy of the model in the entire range of temperatures but gives a good idea of its effective range of usefulness. These values of ε have been utilized to give r_0 from the viscosity and self-diffusion data. From these the force constants μ and λ have also been evaluated and are likewise found to vary with temperature. These variations of ε, r_0, μ and λ have been explained theoretically and are shown to be in accord with experimental data on the second virial coefficients of argon. The force constants for O_2, N_2, CH_4 and CO have also been similarly determined and are found to agree with other determinations. A.

539.132

5619. On the quantum theory of spectroscopic phenomena of the hydrogen bond. N. D. Sokolov. *Dokl. Akad. Nauk SSSR*, **82**, *No.* 3, 369–72 (1952) *In Russian.*

A quantum mechanical treatment of the frequency shift of the A–H group in RA–H . . . BR (A, B = N, O, F) as compared with that of the isolated A–H group. The H, B repulsion energy depends on the effective nuclear charge Z of H, which in turn depends

on R_{AH}. The results confirm the assumption that an increase in R_{AH} increases the proton content of H in such compounds. J. JACOBS

539.132

5620. On the theory of spectroscopic phenomena of the hydrogen bond. N. D. SOKOLOV. *Zh. eksper. teor. Fiz.*, **23**, *No.* 4 (10) 392–403 (1952) *In Russian.*

An extended version of the preceding abstract. Among the unavoidable factors which determine the magnitude of the frequency shift is not only the dependence of $\tilde{z}$ on R_{AH}, but also the lengthening of the bond A–H during formation of the system. This extension requires anharmonicity of vibrations.

J. JACOBS

539.132

5621. Theories of electronic spectra of organic molecules. C. SANDORFY. *Cahiers de Phys., No.* 41, 37–53 (*Jan.*, 1953) *In French.*

A summary is given of elementary quantum mechanics and its applications to organic molecules.

A. J. TAYLOR

539.132

5622. Influence of the steric effect and of cyclization on the electronic structure of carbon and nitrogen. P. RAMART-LUCAS. *Cahiers de Phys., No.* 41, 1–36 (*Jan.*, 1953) *In French.*

Conventional chemical formulae do not account for the interactions between the various elements present which may lead to a profound modification of the electronic structure upon which the chemical behaviour depends. The present work illustrates in a comprehensive and systematic study of u.v. and visible absorption spectra, the modification of electronic structure by the steric effect and the cyclization process. The bonding of two chromophores A and B, where A is frequently a benzene nucleus and B an ethylenic or other double bonded system sometimes containing a hetero N atom, usually leads to a system AB which must be regarded as a single chromophore. Steric hindrance between groups (e.g. Me and Me_3) attached to the components A and B of the molecule may however inhibit the coupling, leading to a spectrum characteristic of the individual components. The same effect may be produced by cyclization which may also, however, operate otherwise producing coupling between two systems A and B originally uncoupled energetically. Many examples are given illustrating each type of behaviour. H. H. GREENWOOD

539.132

5623. A study of three-center integrals useful in molecular quantum mechanics. R. S. BARKER AND H. EYRING. *J. chem. Phys.*, **21**, 912–17 (*May*, 1953).

An integrated equation for the three-centre nuclear attraction integral has been formulated in a general way for Slater-type atomic s orbitals arising from any integral principle quantum number. No restrictions are placed on the effective nuclear charges or the interatomic distances. The formulation is expressed linearly in terms of certain auxiliary functions which are discussed in detail. Numerical values of some of the auxiliary functions for the triatomic hydrogen molecule are cited as examples of this exact formulation. An alternative approximate formulation is also given. A.

539.132

5624. On the nature of the exchange energy: definition of the most localized orbitals. R. DAUDEL. *C.R. Acad. Sci.* [*Paris*] **236**, 1036–8 (*March* 9, 1953) *In French.*

The view that the nature of the exchange energy is different from that of the Coulombic energy would seem to be no longer tenable. The total wave-function for a molecular system can be described in terms of symmetry orbitals ψ or alternatively by equivalent orbitals χ. Since the χ are generally strongly localized the exchange energy between them is small compared with that of the corresponding description in terms of the ψ orbitals. That the exchange energy for a system in a given energy state can vary in this way underlines its formal character. The most localized orbitals ϕ are defined as those which make the exchange energy a minimum. It is thought that these probably differ little from the χ.

H. H. GREENWOOD

539.132

5625. The bipyramidal XY_5 molecular model. I. Classical vibration problem. J. S. ZIOMEK AND C. B. MAST. *J. chem. Phys.*, **21**, 862–9 (*May*, 1953).

Symmetry co-ordinates are set up from the standpoint of group theory for describing the normal modes of oscillation of the XY_5 molecular model in such a manner that maximum factorization of the secular determinant is accomplished. The cubic and quartic portions of the anharmonic potential function are derived, and the components of vibrational angular momentum are set down. The complete valence-type potential function is discussed. Explicit relations are derived between the force constants occurring in the secular determinant and the physical valence force constants. A.

539.132

5626. The united atom treatment of H_2^+. F. A. MATSEN. *J. chem. Phys.*, **21**, 928–9 (*May*, 1953).

Using first-order perturbation theory on the united atom, closed expressions are obtained for the energies, and the charges which minimize those energies, of the following states: $1s\sigma$, $2p\sigma$, $2p\pi$, $3p\pi$ and $3d\delta$. Numerical calculations based on these expressions show, for the higher states, quite good agreement with the more exact calculations of Teller and Chakravarty. A.

539.132

5627. Intensity distribution in vibration spectra of linear chains. L. I. VIDRO AND B. I. STEPANOV. *Dokl. Akad. Nauk SSSR*, **82**, *No.* 4, 557–60 (1952) *In Russian.*

Expressions are derived for the intensity of lines in infrared and combination spectra for two simple models of linear chains consisting of $2n + 1$ bonds which are (*a*) equal, and (*b*) of two alternating types with different quasi-elastic constants. A. GELBTUCH

539.132

5628. Quantum mechanical determination of the vibration frequencies of a compound with a hydrogen bond. N. D. SOKOLOV. *Zh. eksper. teor. Fiz.*, **23**, *No.* 4 (10) 404–11 (1952) *In Russian.*

The vibration frequencies of the linear triatomic system A–H . . . B with a H-bond were investigated.

The most probable optical transition corresponds to a frequency differing little (~20%) from that obtained classically. An approx. proportionality exists between the A–H frequency shift under compound formation and the energy of the H-bond. J. JACOBS

539.132

5629. On the fundamental vibrations of ammonia and the ammonium ions. I. GAMO. *C.R. Acad. Sci.* [*Paris*] **236,** 911–12 (*March* 2, 1953) *In French.*

Most calculations of normal vibrations do not account for the anharmonicity of the potential function. As this might well be important for molecules containing H atoms, this has been taken into account for the calculation of frequencies and force constants of NH_3, NH_4^+ and ND_4^+. The potential function of Urey and Bradley was used.

A. J. TAYLOR

539.132

5630. Loose transition states involving internal rotation. N. W. LUFT. Letter in *J. chem. Phys.*, **21,** 754–5 (*April*, 1953).

The activation energy of recombination of methyl radicals is found to be zero, which was explained by the fact that the radicals retain their freedom of rotation in the transition state. The potential energy of the radicals is expressed as the difference between bond energy and repulsive energy. In $(CH_3)_2$ the distances of the odd electrons and of the electric multipoles from the centre of gravity are small in comparison with the C–C distance, so the barriers opposing rotation are very small. The potential curve shows no maximum. For $(C_6H_5CH_2)_2$ the lone electrons are close to the centre of gravity, but the multipole origins far from it, so rotations are restricted, and in the transition state they are reduced to vibrational movements. Radicals in transition state possess internal rotational degrees of freedom only if the repulsion is small compared with the bond energy. Some experimental dissociation energies, such as that of hydrazine, may be reinterpreted with these considerations. A. J. TAYLOR

539.132

5631. Potential function for the out of the plane vibrations of C_2H_3Br and its seven deuterated substitutes and the effect of anharmonicity on the calculation. C. MANNEBACK AND A. RAHMAN. *Ann. Soc. Sci. Bruxelles*, **67,** *No.* 1, 28–67 (1953).

The dimensions of C_2H_3Br were chosen so that the observed moments of inertia were accounted for. The eight isotopic molecules were investigated and the observed frequencies assigned satisfactorily. The relations found by Decius and Wilson [Abstr. 439 (1952)] were used for the description of the non-planar vibrations, and from these the values of the three diagonal and the squares of the three non-diagonal coefficients were found. The effect of anharmonicity on the frequencies and on the diagonal constants is shown. The relations are well satisfied by the experimental data. The accuracy of the coefficients found varies: the non-diagonal constants are less reliable than the diagonal constants. The signs of the non-diagonal constants can only be determined by trying the various possibilities and finding the best possible set of frequencies. As the values are considerable this does not result in ambiguity. The relations of Decius and Wilson are a good test for the correctness of observed frequencies.

A. J. TAYLOR

539.132

5632. Nuclear quadrupole resonance of CH_2ClCO_2H. A. BASSOMPIERRE. *C.R. Acad. Sci.* [*Paris*] **236,** 799–800 (*Feb.* 23, 1953) *In French.*

Theoretical. The factor $\partial_\phi^2/\partial_z$ (ϕ = electric potential, z-axis along the C–Cl bond) determining the nuclear quadrupole frequency of Cl is calculated by standard molecular orbitals methods. The result is expressed in terms of hybridization coefficients.

L. PINCHERLE

539.132

5633. The vibration frequencies of the halogenated methanes and the substitution product rule. K. S. PITZER AND E. GELLES. *J. chem. Phys.*, **21,** 855–8 (*May*, 1953).

The extension of the Teller–Redlich product rule to the substitution of different atoms or groups, which was previously applied to the methyl benzenes, is here applied to the halogenated methanes. The rule is found to hold accurately enough to be useful in assigning fundamental frequencies or in computing unobserved fundamentals. A.

539.132

5634. Normal coordinate analysis of the nonplanar vibrations of 1, 3, 5-trifluorobenzene. E. FERGUSON. *J. chem. Phys.*, **21,** 886–90 (*May*, 1953).

An analysis has been carried out based on the frequency assignments of Nielsen, Liang and Smith, and utilizing results from Miller and Crawford's normal co-ordinate treatment of the non-planar vibrations of benzene. The analysis has furnished strong support for Nielsen, Liang and Smith's tentative assignment of the lowest A_2'' fundamental, and has led to the conclusion that their value for the highest E'' fundamental is too high. The spectral data have been re-examined, and a reasonable new assignment has been given for this E'' fundamental. A plausible reinterpretation consistent with the change in assignment of the E'' fundamental has been given of several of the combination and overtone bands. A.

539.132

5635. Substituted methanes. XIV. Vibrational spectra, potential constants, and calculated thermodynamic properties of bromochloromethane. A. WEBER, A. G. MEISTER AND F. F. CLEVELAND. *J. chem. Phys.*, **21,** 930–3 (*May*, 1853).

For Pt XIII, see Abstr. 3120 (1953). Raman displacements, semiquantitative relative intensities, quantitative depolarization factors and wave numbers for the infrared bands in the region 400–3000 cm^{-1} have been obtained for CH_2BrCl. A reasonable set of potential constants has been determined using Wilson's *FG* matrix method. The thermodynamic properties—heat content, free energy, entropy and heat capacity—have been calculated from the spectroscopic and molecular structure data for 11 temperatures from 100 to 1000°K. A.

539.132

5636. A semi-empirical theory of the electronic spectra and electronic structure of complex unsaturated molecules. II. R. PARISER AND R. G. PARR. *J. chem. Phys.*, **21**, 767–76 (*May*, 1953).

For Pt I, see Abstr. 3508 (1953). The theory is further developed and applied to ethylene, butadiene, benzene, pyridine, pyrimidine, pyrazine and *s*-triazine. A realistic and consistent LCAO MO π-electron theory should allow the σ-electrons to adjust themselves to the instantaneous positions of the mobile π-electrons. This is accomplished in the theory by assignment of empirical values to the Coulomb electronic repulsion integrals and Coulomb penetration integrals which enter the formulae, these values being obtained in a prescribed way from valence state ionization potentials and electron affinities of atoms. Use of the empirical values in the molecular orbital theory reduces the magnitude of computed singlet-triplet splittings and the effects of configuration interaction without complicating the mathematics. From the valence-bond point of view, ionic structures may be said to be enhanced. The applications to hydrocarbons and heteromolecules which are considered show that the theory can correlate known π-electron spectral wavelengths and intensities very successfully. A.

539.132

5637. Study of the quadrupole resonance line of *p*-dichlorobenzene. Y. AYANT AND M. BUYLE-BODIN. *C.R. Acad. Sci.* [*Paris*] **236**, 800–2 (*Feb.* 23, 1953) *In French.*

The form of the line was determined with sufficient accuracy to obtain its second moment within a few per cents. Results are in agreement with formulae derived by an extension of Van Vleck's trace methods. L. PINCHERLE

539.132

5638. On the electric quadrupole resonance of chlorine in Cl_2Hg. M. BUYLE-BODIN AND A. MONFILS. *C.R. Acad. Sci.* [*Paris*] **236**, 1157–60 (*March* 16, 1953) *In French.*

Observations were made at −196, −112, 20 and 100°C on Cl^{35} and Cl^{37}; the frequency ratio $\nu 35/\nu 37 = Q_{35}/Q_{37}$ is independent of temperature and identical for both observed frequencies. The temperature dependent frequency difference is extrapolated to zero at 275°C, the Cl_2Hg melting point. The degree of ionicity of Hg–Cl is 55% approx. J. JACOBS

539.132

5639. On "molecular diagrams" in atomic orbital methods. A. LAFORGUE. *C.R. Acad. Sci.* [*Paris*] **236**, 923–6 (*March* 2, 1953) *In French.*

It is shown that computations based on the method of spin states may yield the same ionization energies as are found by molecular orbital methods. This is exemplified by a treatment of H_3 and H_3^+. A. J. TAYLOR

539.132

5640. Molecular orbital theory of alternant hydrocarbons. R. B. POTTS. Letter in *J. chem. Phys.*, **21**, 758–9 (*April*, 1953).

It is shown how the eigenvalues and eigenvectors of the real symmetric matrix of the secular determinant of an alternant molecule can be found for the calculation of molecular orbitals. A. J. TAYLOR

539.132

5641. Effect of 3*p* atomic orbital on energy of the double bond. J. S. DOOLING. *J. chem. Phys.*, **21**, 859–62 (*May*, 1953).

The energy of the π–π part of the double bond is calculated by (1) the perturbation method using the "united atom" model, and (2) the MO method where the wave-function used is constructed as a linear combination of atomic orbitals, as a function of internuclear distance. In each case the wave-function includes the 3*p* atomic orbital. The results of the investigation indicate (1) that the wave-function ordinarily used in the MO method is not appreciably improved by the inclusion of the 3*p* atomic orbital, and (2) that the absolute value of the energy calculated by the MO method using *p* functions centred at the nuclei, is at least 20% too low at the distances occurring in the C–C bond. A.

539.132 : 548.736.3

5642. The structure of B_4Cl_4. G. H. DUFFEY. Letter in *J. chem. Phys.*, **21**, 761 (*April*, 1953).

A set of electron orbitals, consistent with the X-ray data on structure, is suggested. A. R. STOKES

539.133

5643. On the state of the valences in the compound $FeCuO_2$. C. DELORME AND F. BERTAUT. Letter in *J. Phys. Radium*, **14**, 129–30 (*Feb.*, 1953) *In French.*

$FeCuO_2$ is rhombohedral: each Fe is surrounded by eight O atoms and each Cu has two O neighbours in a straight line. The compound is considered electrostatically. Two ionic formulae are possible: $Fe^{+++}Cu^{+}O_2^{--}$ and $Fe^{++}Cu^{++}O_2^{--}$. The way in which the compound is prepared, the co-ordination number and the atomic distances suggest the former. The electrostatic energy is calculated and the homopolar energy evaluated from comparison with other compounds. The energy value found also suggests the first ionic structure. A. J. TAYLOR

539.133 : 535.343.4–15

The infrared spectrum and the structure of the molecule SiH_3Cl. *See Abstr.* 5397

539.133

5644. The molecular structure, dipole moment, and *g* factor of ozone from its microwave spectrum. R. TRAMBARULO, S. N. GHOSH, C. A. BURRUS, JR AND W. GORDY. *J. chem. Phys.*, **21**, 851–5 (*May*, 1953).

Four low-*J* rotational transitions of O_3^{16} have been measured in the region from 42 to 118 Mc/s. The rotational spectroscopic constants found are $A = 106\,530{\cdot}0 \pm 1{\cdot}1$, $B = 13\,349{\cdot}06 \pm 0{\cdot}06$, $C = 11\,834{\cdot}3 \pm 1{\cdot}1$ Mc/s. The oxygen nuclei form an isosceles triangle with an apex angle of 116° 49′ ± 30′, and the two equal internuclear distances are $1{\cdot}278 \pm 0{\cdot}003$ Å. From the Stark splitting of the $2_{0,2} \rightarrow 1_{1,1}$ transition, the dipole moment is $0{\cdot}53 \pm 0{\cdot}02$ debye. Zeeman splittings of this transition show that ozone is not significantly paramagnetic. A.

539.133

5645. The structure of phosphine. M. H. SIRVETZ AND R. E. WESTON, JR. *J. chem. Phys.*, **21**, 898–902 (*May*, 1953).

Several low-*J* microwave transitions of PH_2D and

PHD_2 have been observed in the *K* band. The effect of centrifugal distortion on the rotational levels has been taken into account approximately, with the result that errors in the computed structure due to this cause now appear to be negligible in comparison with those due to vibration-rotation interaction. One obtains for the P–H distance 1·4177 and 1·4116 Å in the two cases; for the H–P–H angle, 93° 21·6′ and 93° 15·4′. The dipole moment has been measured for both species with agreement within experimental error. A.

539.133

5646. The methods of calculating dipole moments. A. LAFORGUE. *Cahiers de Phys., No.* 42, 42–63 (*March*, 1953) *In French.*

A survey of the quantum mechanical method. The dipole moments associated with asymmetric carbon atomic *s-p* hybrid orbitals are shown to be: dig = 2·33, trig = 2·19, tetra = 2·01 d.u. The moment of a bond is separated into components, namely the atomic moment due to the asymmetry about their corresponding nuclei of the two atomic orbitals forming the bond, the overlap (homopolar) moment due to the asymmetry about the mid-point of the bond of these overlapping atomic orbitals, and the ionic moment due to the different weights with which the two orbitals contribute to the bond wave-function. These components are exemplified in calculating the C–H bond moment. The method for conjugated systems is described, the disparity between experimental and theoretical values for non-alternant hydrocarbons being attributed to the lack of self-consistency. The same failing is characteristic of the calculation of the moments of heterosystems.

H. H. GREENWOOD

539.133

5647. Application of the Fermi–Thomas model in computing the dipole moment of iodine chloride. H. GLAZER AND H. REISS. *J. chem. Phys.*, **21**, 903–7 (*May*, 1953).

The Fermi–Thomas statistical method is applied to the molecule ICl and the non-linear boundary value problem solved by means of the relaxation method of Southwell. In this manner it is possible to construct an electron density map for ICl and to compute its dipole moment. The computed moment compares favourably in magnitude with the measured and has the correct sense. It appears as though the statistical method will be useful in estimating the senses of dipole moments when they are not clearly evident from experiment. A.

ATOMIC STRUCTURE . NUCLEUS . ISOTOPES
539.15

539.152.1

5648. Shell model and nuclear structure. V. F. WEISSKOPF. *Physica*, **18**, 1083–90 (*Dec.*, 1952).

A review of the situation in nuclear theory arising from the difficulties in understanding the reasons for the success of the shell model. Results of calculations by C. Porter on the scattering of 0–3 MeV neutrons by a potential well. [See experiments of Barschall, Abstr. 6074 (1952)]. W. J. SWIATECKI

539.152.1

5649. Excited states of even-even nuclei. G. SCHARFF-GOLDHABER. *Physica*, **18**, 1105–9 (*Dec.*, 1952).

Assignments based on conversion coefficients, K/L ratios, γ-γ and β-γ correlations, relative intensities of *L*-conversion lines, half-lives and angular correlations in nuclear reactions show that 54 1st excited states are 2+, 2 are 0+ and that 2nd excited states are equally 2+ and 4+. A plot of energies of the 1st state against *N* shows pronounced peaks at magic numbers. W. J. SWIATECKI

539.152.1

5650. The first excited state of even-even nuclei. P. PREISWERK AND P. STÄHELIN. *Physica*, **18**, 1118–19 (*Dec.*, 1952).

Disintegrations leading to S^{34}, Se^{78}, Zr^{92}, $Mo^{92,96}$, Sn^{120}, Hg^{196} were re-examined and the first excited levels found to fit into the general behaviour for even-even nuclei. For such nuclei the 1st excited level is highest at shell limits, suggesting that in between shells it is a mixture of proton and neutron excitations. No evidence for sub-shells between $N, Z = 28, 38, 50, 64, 82, 92, 126$ was found. W. J. SWIATECKI

539.152.1

5651. A new parameter for use in discussions of the shell model of the nucleus. N. FEATHER. Letter in *Phil. Mag.*, **44**, 103–5 (*Jan.*, 1953).

The note draws attention to a method of using certain experimental results, which focuses attention on the differences between the properties of real nuclei and those predicted by the liquid drop model. L. PINCHERLE

539.152.1

5652. Nuclear matrix elements of β transitions for odd nuclei. R. NATAF. *J. Phys. Radium*, **14**, 72–7 (*Feb.*, 1953) *In French.*

Using the model of a single particle in an unspecified central potential the angular factors in the matrix elements are calculated for the different types of allowed and forbidden transitions, assuming pure tensor coupling. W. J. SWIATECKI

539.152.1

5653. Nuclear polarization of cobalt 60. E. AMBLER, M. A. GRACE, H. HALBAN, N. KURTI, H. DURAND, C. E. JOHNSON AND H. R. LEMMER. Letter in *Phil. Mag.*, **44**, 216–18 (*Feb.*, 1953).

Experiments were carried out to try to polarize Co nuclei in salts of the type $3Co(NO_3)_2.2M(NO_3)_3.24H_2O$ (M a trivalent ion) where previous experiments had shown that $A = B$ (and therefore there is no alignment in zero field) for probably two-thirds of the Co ions. Anisotropies in the γ-ray intensity parallel and perpendicular to the polarizing field up to 50% were observed, and curves are given showing the anisotropy as function of the reciprocal of the magnetic temperature. Further experiments are in progress to determine the contribution to the anisotropy from nuclei of ions with $A \neq B$. L. PINCHERLE

539.152.1

5654. The atomic nucleus and its constituents. R. E. PEIERLS. *Proc. Phys. Soc.* [*London*] *A*, **66**, 313–24 (*April*, 1953).

A non-technical account of some fundamental

questions in nuclear theory including qualitative arguments about 2-body scattering, saturation, field theories of nuclear forces and the shell model.

W. J. SWIATECKI

539.152.1

5655. Nuclear radiofrequency spectra of D_2 and H_2 in intermediate and strong magnetic fields. N. J. HARRICK, R. G. BARNES, P. J. BRAY AND N. F. RAMSEY. *Phys. Rev.*, **90**, 260–6 (*April* 15, 1953).

The molecular beam apparatus previously described [Abstr. 7475 (1952)] has been improved and has been used to make measurements on the nuclear radiofrequency spectrum of H_2 at intermediate and high magnetic fields. These measurements are the first to provide a test of the theory of molecular H_2 at intermediate magnetic fields and provide a more accurate test of the theory at strong magnetic fields. Agreement of the intermediate field results with the predictions from the high and very low field measurements was found to within experimental error. The numerical values of the interaction constants c and d occurring in the Hamiltonian and the physical quantities that can be calculated therefrom were improved by these measurements. The best values of c and d for H_2, obtained from the intermediate field measurements, are 113 904 ± 30 c/s and 57 671 ± 24 c/s respectively. Measurements were also made on the nuclear spectrum of D_2 at a stronger external magnetic field than any used previously. These measurements improved the numerical values of interaction constants for D_2. The best values of c and d for D_2 are 8788 ± 40 c/s and 25 237 ± 10 c/s respectively. The comparison of c for H_2 and D_2 indicates that the magnetic shielding of the nuclei should differ in these molecules in accordance with $^{D}\sigma/^{H}\sigma = 1{\cdot}006 \pm 0{\cdot}005$.

A.

539.152.1

5656. Spin and parity of the 2·3-MeV excited state of Te^{124}. F. R. METZGER. Letter in *Phys. Rev.*, **90**, 328 (*April* 15, 1953).

The 1–0·094 $\cos^2\theta$ correlation for the 1·7–0·6 MeV cascade indicates spin 3, and conversion measurements odd parity, for the 2·3 MeV state. Similarly, the 2·66 MeV state is probably 3 —. Log ft values point to a 4+ ground state of Sb^{124}.

W. J. SWIATECKI

539.152.1

5657. Nuclear magnetic resonance measurements of selenium. H. E. WALCHLI. Letter in *Phys. Rev.*, **90**, 331 (*April* 15, 1953).

A chemical shift of $1{\cdot}5\times10^{-3}$ was found between the H_2Se and H_2SeO_3 selenium resonance fields. The Se^{77} proton frequency ratio was calculated to be 0·190959 ± 0·000017, in agreement with previous measurements.

L. PINCHERLE

539.152.1 : 621.389

5658. Nuclear resonance spectrometer. L. MALLING. *Electronics*, **26**, 184–7 (*April*, 1953).

The sample is placed in a unidirectional magnetic field on which is superposed a r.f. field. Resonance, which occurs at widely different frequencies for the various isotopes, is detected by the voltage it induces in a small coil. If the frequency of the r.f. field is swept through a band a pulse may be observed on a c.r.t. screen as the nuclear resonance frequency is passed through. This method of display requires a bandwidth of ~1 kc/s and does not give the s./n. ratio needed in the extremely sensitive receivers used. When the time taken to make a measurement is unimportant, the bandwidth may be artificially reduced to <1 c/s with a vast improvement in s./n. ratio, enabling sensitivities of a $\sim10^{-8}$ V to be achieved. The method is described and a block diagram of the equipment is given.

W. G. STRIPP (R)

539.152.2

5659. Spin and nuclear moments of palladium 105. J. BLAISE AND H. CHANTREL. Letter in *J. Phys. Radium*, **14**, 135 (*Feb.*, 1953) *In French.*

From h.f.s. observations $I = 5/2$ and $\mu = -0{\cdot}57$ n.m. Deviations from the interval rule were observed.

L. PINCHERLE

539.153

5660. The Fok self-consistent field for the configuration $1s^22p^2$ of the beryllium atom. A. P. YUTSIS AND G. K. TSYUNAĬTIS. *Zh. eksper. teor. Fiz.*, **23**, *No.* 5 (11) 512–16 (1952) *In Russian.*

The Fok equations are solved for the configuration $1s^22p^2$ of the Be atom. The normalized solutions are given in the form of a table. The values of the energy are determined with the help of these solutions. A comparison of the results obtained with the results of the investigation of Morse, Young and Haurwitz [*Phys. Rev.*, **48**, 948 (1935)] shows that the energies determined with the help of the solutions of the Fok equations for the terms ^3P, ^1D and ^1S are by 0·020, 0·024 and 0·031 atomic units, respectively, in better agreement with experimental data than the energies determined with the help of the analytic wave-functions.

E. RABKIN

539.153

5661. Triplet splitting of the terms of atoms with two valence 2p-electrons. A. P. YUTSIS, V. K. SHUGUROV AND G. K. TSYUNAĬTIS. *Zh. eksper. teor. Fiz.*, **23**, *No.* 5 (11) 517–24 (1952) *In Russian.*

Formulae are given for the splitting. With the help of analytical wave-functions the triplet state is determined for atoms of the He type in the configurations $2p^2$ and of the Be type in the configuration $1s^22p^2$. The triplet splitting of the Be atom in the configuration $1s^22p^2$ and also the splitting of the main configuration of the neutral C atom and of the doubly ionized O atom are determined with the help of single electronic wave-functions which are solutions of the equations of Fok's self-consistent field. The theoretical results obtained are compared with the experimental data. The data show that the triplet splitting determined with the help of analytical single electronic wave-functions is adequate for the study of the course of the triplet splitting in iso-electronic systems. Owing to the fact that the analytical wave-functions are approximate, there is a certain deviation between the theoretical results and the experimental data. In the case of Be this deviation is considerable. The results obtained show that the triplet splitting calculated with the aid of the single electronic wave-functions of the Fok self-consistent field agrees well with the experimental data. The Be atom again represents an exception, in which the deviation between the theoretical and the experimental

values at the upper range of the triplet approaches 30% of the experimental value. However, the use of the wave-functions of the Fok self-consistent field gives better agreement between the theoretical results and the experimental data than the results obtained with the help of the analytical wave functions.

E. RABKIN

539.153

5662. Optical creation of an inequality of population between the Zeeman sub-levels of the ground state of atoms. J. BROSSEL, A. KASTLER AND J. WINTER. Letter in *J. Phys. Radium*, **13**, 668 (*Dec.*, 1952) *In French.*

The unsuccessful attempt to produce this in Hg vapour [Abstr. 5994 (1952)] was repeated with an atomic beam of Na (to reduce collisions) and a positive effect of ~16% was found. W. J. SWIATECKI

539.153

5663. Double excitation of the two-electron atom. P. KESSLER. *C.R. Acad. Sci.* [*Paris*] **236**, 1335–7 (*March* 30, 1953) *In French.*

For an electric dipole transition from the configuration $(ls)^2$ to (n_1s, n_2p) and (n_1p, n_2d), the inter-electron interaction being the perturbation effective, the transition probabilities are calculated for some small values of (n_1, n_2). R. H. DALITZ

539.153

5664. Calculation of the 1*s*-2*s* electron excitation cross section of hydrogen by a variational method. H. S. W. MASSEY AND B. L. MOISEIWITSCH. *Proc. Phys. Soc.* [*London*] *A*, **66**, 406–8 (*April*, 1953).

Moiseiwitsch's modification (1951) of Hulthén's (1944) and Kohn's (1948) methods is tested by comparison with the results of the Born–Oppenheimer and the "Distorted Wave" (Erskine and Massey, 1952) approximations. With the crude trial functions used, there are considerable discrepancies, especially near threshold. W. J. SWIATECKI

539.153.4

5665. Fock equations in many-configuration approximation. A. P. YUTSIS. *Zh. eksper. teor. Fiz.*, **23**, *No.* 2 (8) 129–39 (1952) *In Russian.*

Interaction of configurations is replaced by the term *many-configuration approximation*; here the atomic wave-function is a linear combination of single-configuration wave-functions. The one-electron wave-functions in the many-configuration approximation are newly determined by Fock's self-consistent field technique. J. JACOBS

539.155.1

5666. Mass synchrometer doublet measurements at masses 28 and 30. L. G. SMITH AND C. C. DAMM. Letter in *Phys. Rev.*, **90**, 324 (*April* 15, 1953).

A table is given of the mass difference of these doublets, as measured by the radio-frequency mass spectrometer, with which the masses of the ions are measured in terms of high harmonics of their cyclotron frequencies. The results are found to be in essential agreement with the values obtained from nuclear disintegration studies, but not with most recent mass spectrometric measurements. J. HUGHES

RADIOACTIVITY . α-, β- AND γ-RAYS 539.16

539.16 : 553.495

5667. Distribution of radioactivity in Switzerland. R. PAYOT AND A. JAQUEROD. *Mem. Soc. Phys. Hist. Nat. Genève*, **42**, *No.* 3, 257–320 (1953) *In French.*

A rapid survey, made by analysing spring water from various likely regions, showed that radioactivity is feeble in Switzerland, and no important deposits of uranium exist. The zones of maximum activity have been mapped. A.

539.16.08

5668. Determination of small quantities of radon by a counting method. R. BOULANGER. *J. Belge Radiol.*, **35**, 569–77 (1952) *In French.*

A general description (no figures) of the use of an ionization chamber for measuring 10^{-10} to 10^{-13} c/litre concentrations of Rn is given. The possibilities of using active carbon for determining small amounts of Rn and for purifying air containing Rn are discussed. NUCLEAR SCIENCE ABSTRACTS

539.16.08

5669. Dosimetry of radioactive substances. A simple method of measuring the specific activity of radioactive solutions. K. SOMMERMEYER. *Strahlentherapie*, **88**, 345–51 (1952) *In German.*

A small cylindrical open ionization chamber is brought near the surface of radioactive solutions for the purpose of measuring the share contributed by the β-radiation to the current passing through the chamber. The portion of current deriving from the β-radiation is nearly proportional to the produce of the specific activity and the average β-energy, if the chamber has the appropriate dimensions. By means of this arrangement it is, therefore, possible to determine in a very simple way the specific activities of radioactive solutions, including solutions of isotopes with very small β-energies such as S^{35} and C^{14}. The technical details of the procedure are discussed in full. NUCLEAR SCIENCE ABSTRACTS

539.16.08 : 550.42

Ionium determination in deep-sea sediments. *See Abstr.* 5795

539.16.08 : 615.849.7

The use of tracers in chemical dosimetry. *See Abstr.* 5826

539.162

5670. Rotation levels and rotation spectra of heavy nuclei. S. G. RÝZHANOV. *Zh. eksper. teor. Fiz.*, **23**, *No.* 4 (10) 417–24 (1952) *In Russian.*

A new scheme of α- and γ-spectra of naturally radioactive nuclei is proposed: the parent nucleus undergoing α-decay in the ground state imparts energy to 2 or 3 rotators; and γ-radiation is determined by transiton of each rotator, subject to selection rules. The γ-intensities can be obtained, using the correspondence principle, from electrical quadrupole—together with some magnetic dipole—emission. J. JACOBS

539.163.1

5671. Interpretation of experimental results obtained by the method of delayed coincidences. R. BALLINI AND A. BERTHELOT. *J. Phys. Radium*, **14**, 1–8 (*Jan.*, 1953) *In French.*

Calculations are given which enable the lifetimes of

short-lived decay-products to be evaluated from delayed-coincidence measurements, with full corrections for spurious coincidences, counter efficiencies and counter dead times. J. J. WILKINS

539.163.1

5672. The short-lived radioisotopes P^{28} and Cl^{32}. N. W. GLASS, L. K. JENSEN AND J. R. RICHARDSON. Letter in *Phys. Rev.*, **90**, 320 (*April* 15, 1953).

Using a scintillation γ-spectrometer and NaI crystal the reactions $Si^{28}(p \geqslant 15{\cdot}6 \pm 0{\cdot}5$ MeV, $n)P^{28}$ and $S^{32}(p \geqslant 14{\cdot}3 \pm 0{\cdot}5$ MeV, $n)Cl^{32}$ were studied. The half-lives were $0{\cdot}280 \pm 0{\cdot}010$ and $0{\cdot}306 \pm 0{\cdot}004$ sec respectively. Positrons and γ's, but no α's were found. Gammas from $Mg^{24}(p, n)Al^{24}$ were also observed. W. J. SWIATECKI

539.163.1

5673. The β^- half-life of Pu^{241}. D. R. MACKENZIE, M. LOUNSBURY AND A. W. BOYD. Letter in *Phys. Rev.*, **90**, 327 (*April* 15, 1953).

Mass-spectrometer and α-pulse analyses of the Pu and Am daughter give $13{\cdot}0 \pm 0{\cdot}2$ years. W. J. SWIATECKI

539.163.2

5674. Studies on radioactive bromine. E. BERNE. *Acta polytech. Chem. Met. Ser.*, **3**, *No.* 3, 46 *pp.* (1952).

The half-life of Br^{82} has been determined to be $36{\cdot}0 \pm 0{\cdot}2$ hr. The preparation of Br^{82} with high specific radioactivity from material irradiated in the Harwell pile is described. A Szilard-Chalmers reaction is used, and Br^{82} is separated using a new type of anion-exchanger. The retention and decomposition of $KBrO_3$ during irradiation in the pile have been investigated, and the results have been applied to a calculation of the maximum concentration factor, which is found to be 10^2. Using an improved irradiation technique it should be possible to increase the concentration factor to 10^3. The analytical determination of Br^{82} has been investigated. The back-scattering, absorption and self-absorption of the radiation have been studied. It has been found possible to calculate self-absorption factors from measured values of the absorption in Al and values of the back-scattering factors. NUCLEAR SCIENCE ABSTRACTS

539.163.2

5675. The decay scheme of ^{106}Rh. D. E. ALBURGER. *Physica*, **18**, 1110–11 (*Dec.*, 1952).

Studies with a β-spectrometer, NaI scintillation spectrometer and photoelectric conversion in U and Pb reveal 4 β's and 6 γ's, consistent with the following level scheme for Rh^{106}: 0 + (ground); 0·513 MeV 2+; 1·137 MeV 0+; 1·55 MeV 2+; 2·42 MeV 2+. W. J. SWIATECKI

539.163.2

5676. Decay scheme of magnesium 28. R. K. SHELINE AND N. R. JOHNSON. Letter in *Phys. Rev.*, **90**, 325 (*April* 15, 1953).

Gamma spectra of chemically separated Mg^{28} from $Mg^{26}(\alpha = 39$ MeV, $2p)Mg^{28}$ show 6 lines which, together with absorption measurements on Mg^{28} and Al^{28} and log ft values, give a decay scheme for the triplet Mg^{28}–Al^{28}–Si^{28}. W. J. SWIATECKI

539.163.2

5677. The decay scheme of natural lutetium 176. J. R. ARNOLD AND T. SUGIHARA. Letter in *Phys. Rev.*, **90**, 332 (*April* 15, 1953).

Spectrometer and crystal-counter coincidence studies show 200 ± 20 keV and 320 ± 20 keV γ's in cascade and no cross-over at 520 keV. No K-capture or decay to the ground state were found for the isomeric state of Lu^{176}. The decay scheme of Goldhaber and Hill [Abstr. 1022 (1953)] is confirmed, though the 90 keV line was not observed. W. J. SWIATECKI

539.163.2

5678. Angular correlations in a many step cascade transformation of a nucleus. A. Z. DOLGINOV. *Zh. eksper. teor. Fiz.*, **23**, *No.* 5 (11) 493–501 (1952) *In Russian.*

Using group theory general formulae are derived in terms of Racah coefficients for the correlations between any 2 particles (or photons) of an N-stage cascade. A numerical illustration is given for the case of a proton captured by a nucleus which then emits an α-particle and 2 γ's. The generalization to take account of a reduction of the correlation by external fields is indicated [Goertzel (1946), Alder (1951)]. Beta-transformations are also treated. W. J. SWIATECKI

539.163.2

5679. Dysprosium 157. T. H. HANDLEY AND E. L. OLSON. Letter in *Phys. Rev.*, **90**, 500 (*May* 1, 1953).

An $8{\cdot}2 \pm 0{\cdot}1$ hr activity was found as a result of $Tb^{159}(p, 3n)Dy^{157}$. The threshold was 19 ± 1 MeV. The γ-spectrum of Dy^{157} shows a peak at 325 keV. The 4·7 day decay of Tb^{157} was not confirmed, showing that the $\frac{1}{2}$-life must be <30 min or >100 yr. W. J. SWIATECKI

539.164

5680. On the α-instability of rare earth nuclides. S. JHA AND G. P. DUBE. *J. Phys. Radium*, **13**, 634–6 (*Dec.*, 1952) *In French.*

The reduced binding energies of the first nucleons to follow closed sub-shells is shown to account for the α-activity of Sm^{147} and Pm^{145}, and permits the prediction of activities in some neighbouring nuclei. J. J. WILKINS

539.164

5681. Calculation of the intensity of fine structure lines of some even-even α-emitters. P. FALK-VAIRANT AND J. TEILLAC. *C.R. Acad. Sci.* [*Paris*] **236**, 914–16 (*March* 2, 1953) *In French.*

The calculation is carried out for the lines corresponding to the first excited state with $J = 2$ by means of both Gamow's and Preston's formulae. A table and a diagram compare results with the experimental data for eight nuclei. It is found that the factor $P_{l=2}$ of Preston's theory is approx. constant and that this theory gives intensities which are too large: thus it appears that the effect of angular momentum is negligible. L. PINCHERLE

539.164.08 : 537.542

5682. Precision counting of alpha particles with special reference to the determination of standard sources. R. HURST AND G. R. HALL. *Analyst*, **77**, 790–800 (*Nov.*, 1952).

Methods of α-particle counting are discussed and

special reference is made to the absolute determination of standard sources by the use of α proportional counters of known low geometry. Operating details of one such counter are discussed.

NUCLEAR SCIENCE ABSTRACTS

539.165

5683. Double β-radioactivity: systematic search for favourable cases. J.-F. Detœuf, R. Moch and J. Salmon. *J. Phys. Radium*, **13**, 618–33 (*Dec.*, 1952) *In French.*

Two semi-empirical mass formulae, together with relevant experimental data on normal β-decay, are used to show that the region $80 < A < 130$ is favourable to double β^--decay. The available energy and half-life are estimated for fourteen isotopes, the most favourable being isotopes of Sn, Pd, Cd, Mo and Ru.

J. J. WILKINS

539.165

5684. The β-spectrum of Ir^{192}. A. A. Bashilov, N. M. Anton'eva and B. S. Dzhelepov. *Izv. Akad. Nauk SSSR, Ser. fiz.*, **16**, *No.* 3, 264–305 (1952) *In Russian.*

The spectrometer was the ketron [Abstr. 4427 (1951)]. Resolving power, according to $\frac{1}{2}$-width of hard conversion lines, was 0·6%; somewhat worse at low $H\rho$ because of source thickness ($< 0{\cdot}2$ mg cm^{-2}). The source was in powder form, stuck on thin paper; detection by G.M. counters. The upper limit of the β-spectrum is 670 ± 10 keV. 28 conversion lines were measured, including three in range $H\rho = 4000$ to 4300, attributed to conversion of γ-transition, 880 ± 4 keV in K, L and M shells of Pt. Absolute internal conversion coefficients are not given, but α_K/α_L is given for 9 conversion lines. A decay scheme of Ir^{192} is proposed.

J. C. E. JENNINGS

539.165

5685. Investigation of the β-spectrum of RaB. É. E. Berlovich. *Izv. Akad. Nauk SSSR, Ser fiz.*, **16**, *No.* 3, 314–21 (1952) *In Russian.*

A twin spectrometer was used, having 90° deflection and shaped pole edges to give cubic focusing; there is no detailed description of the prism. Solid angle accepted was $2{\cdot}5 \times 10^{-3}$ of 4π; resolving power was 1·8% in the half detecting conversion lines, 3% in the half detecting the continuous spectrum. The source was Rn in glass capillary of 4 to 6 μ wall thickness. Coincidences with K-line of 350 keV γ-transition led to a Kurie plot showing upper limit of 670 ± 20 keV and a definite but unexplained break at about 350 keV. The 53 keV γ-line was found to be in cascade with the 241 keV γ-line and to be quadrupolar. It is pointed out that the mass difference between RaB and RaC corresponds to 1020 keV, not 650 keV. J. C. E. JENNINGS

539.165

5686. Beta-spectrum of radium E. J. Pniewski and M. Danysz. Letter in *Nature* [*London*] **171**, 694–5 (*April* 18, 1953).

This was investigated down to 4·6 keV in a magnetic lens β-spectrometer using very thin sources ($\sim 4\ \mu$g/cm^2) and recording the β-particles at the surface of electron-sensitive nuclear emulsions (Ilford *G5*, 25 μ thick). The energy and momentum spectra are given graphically; the energy distribution curve probably cuts the $I(E)$ axis at $I(E) > 0$.

A. O. STANESBY

539.165.2

5687. β-decay of mirror nuclei and the shell model. O. Kofoed-Hansen and A. Winther. Letter in *Phys. Rev.*, **86**, 428–30 (*May* 1, 1952).

Single-particle wave-functions are taken for mirror nuclei with closed shells in both neutrons and protons ± one particle, and a linear expression obtained containing the partial fractions contributed by the Fermi and Gamow–Teller couplings to the β-decay coupling constant. Plotted for 6 transitions, the lines pass through a common point, indicating a partial fraction of 0·5 for each coupling and a value of $(2{\cdot}19 \pm 0{\cdot}03) \times 10^{-49}$ erg cm^3 for the coupling constant g. Other mirror nuclei with more ambiguous shell model wave-functions are discussed.

539.165.2

5688. Matrix elements for mirror transitions. A. Winther. *Physica*, **18**, 1079–82 (*Dec.*, 1952).

The method of the preceding abstract for deducing the mixture of Fermi and Gamow–Teller interactions, if extended to take account of the sharing of angular momentum between the single particle and nuclear core [see A. Bohr and B. Mottelson, *K. Danske Vidensk. Selsk., mat.-fys. Medd.* (to be published)], shows improved consistency in the interpretation of "closed shell plus one" and other mirror transitions.

W. J. SWIATECKI

539.166

5689. Gamma radiation of Fe^{59}. B. S. Dzhelepov, N. N. Zhukovskiĭ and Yu. V. Khol'nov. *Dokl. Akad. Nauk SSSR*, **86**, *No.* 3, 497–9 (1952) *In Russian.*

Experimental curves of the γ-radiations of Fe^{59}, as determined with a γ-ray spectrometer, are shown. The γ-spectrum consists of two lines of $1{\cdot}100 \pm 0{\cdot}011$ and $1{\cdot}278 \pm 0{\cdot}013$ MeV energy and $1{\cdot}39 \pm 0{\cdot}05 : 1$ relative intensity.

NUCLEAR SCIENCE ABSTRACTS

539.166

5690. The strength of electric dipole radiation. B. B. Kinsey and G. A. Bartholomew. *Physica*, **18**, 1112–17 (*Dec.*, 1952).

From the intensities of γ's produced in transitions directly to the ground state or to low excited states for nuclei with $3 \leqslant N \leqslant 38$ it is concluded that E1 radiation near 7 MeV is more probable than higher electric multipoles or M1 radiation. W. J. SWIATECKI

539.166

5691. Study of the γ-rays accompanying the transmutation $^{231}_{91}Pa \rightarrow {}^{227}_{89}Ac$. P. Falk-Vairant and M. Riou. *J. Phys. Radium*, **14**, 65–71 (*Feb.*, 1953) *In French.*

Measurements of the energies and relative intensities of γ-rays and internal-conversion lines are reported, and are discussed together with the known α-particle fine-structure. Multipolarities are deduced for 11 of the γ-rays detected, and an energy-level scheme (incomplete) is suggested for Ac^{227}. J. J. WILKINS

539.166

5692. On the internal bremsstrahlung of Fe^{55}. A. Michalowicz. Letter in *J. Phys. Radium*, **14**, 214–15 (*March*, 1953) *In French.*

The X-radiation and continuous γ-radiation from the pure K-capture nuclide Fe^{55} were studied using a 4π ionization chamber and scintillation spectrometer respectively. The total energy of the transition is

215 ± 10 keV, and the "branching" ratio $N_\gamma/N_K = (4 \pm 1)\times10^{-5}$. The shape of the continuous γ-ray spectrum is in reasonable agreement with theory.

A. O. STANESBY

539.166 : 539.172.3

5693. Excitation of a 16-microsecond state in Ta^{181} by capture of bremsstrahlung. H. N. BROWN AND R. A. BECKER. Letter in *Phys. Rev.*, **90**, 328 (*April* 15, 1953).

A 16 ± 3 μsec photopeak at 130 keV and evidence for γ's near 500 keV from $Ta^{181}(\gamma,\gamma')Ta^{181m}$ were obtained by placing a 0·015″ target in a 6·5 MeV X-ray beam and using a NaI(Tl) detector.

W. J. SWIATECKI

539.166 : 539.17

5694. The spectrum of the radiation emitted during μ-meson capture by carbon. F. D. S. BUTEMENT. Letter in *Phil. Mag.*, **44**, 208–11 (*Feb.*, 1953).

Using 2 photomultipliers dipping from above and below into a tank filled with toluene, and coincidence circuits to exclude γ's due to subsequent nuclear capture and bremsstrahlung from decay electrons, the electromagnetic spectrum given by 127 events was found to consist of a peak around 80 keV. The calculated energy for the $2p$–$1s$ mesonic transition is 77 keV.

W. J. SWIATECKI

539.166.2

5695. Evidence of a mixed E1 + M2 transition and the angular momenta of the Sr^{88} levels. R. M. STEFFEN. Letter in *Phys. Rev.*, **90**, 321 (*April* 15, 1953).

A re-investigation of the directional correlation of γ-rays in Sr^{88}. The experimental directional correlation data were fitted by least squares to an expansion in Legendre polynomials, and the true coefficients A_l obtained by applying corrections for the finite angular resolution of the instruments. Result: $A_2 = -0{\cdot}065 \pm 0{\cdot}003$, $A_4 = -0{\cdot}002 \pm 0{\cdot}003$. These values, with other data, suggest that the spins of the levels of Sr^{88} are 3, 2 and 0, and that the $3 \rightarrow 2$ transition is an electric dipole transition with $1{\cdot}5 - 2\times10^{-4}$ magnetic quadrupole admixture, the two radiations being in phase, while the $2 \rightarrow 0$ transition is pure electric quadrupole radiation.

L. PINCHERLE

539.166.74

5696. On the polarization of gamma-quanta in Compton scattering at 180°. YA. B. ZEL'DOVICH. *Dokl. Akad. Nauk SSSR*, **83**, *No.* 1, 63–6 (1952) *In Russian.*

In the scattering through 180° of circularly polarized γ's by unoriented electrons there is no depolarization, independently of energy. With oriented electrons the cross-section depends on the orientation. An effect of some per cent could be obtained by measuring the change in the scattering in magnetized Fe upon reversal of the field. A simple qualitative interpretation is given.

W. J. SWIATECKI

539.166.835

5697. De-excitation of a nucleus by the creation of positon-negaton pairs. M. RIOU. *J. Phys. Radium*, **13**, 480–4 (*Oct.*, 1952) *In French.*

Review of theoretical and experimental knowledge of internal pair creation: probabilities, energy and angular distributions for various electric and magnetic multipoles, case of $0 \rightarrow 0$ (no) transitions (O^{16}). Internal creation with monoenergetic positons.

W. J. SWIATECKI

539.166.835

5698. Allowed final states for annihilation into three photons. F. G. FUMI AND L. WOLFENSTEIN. Letter in *Phys. Rev.*, **90**, 498 (*May* 1, 1953).

A study of the consequences of invariance under rotations and reflections for annihilations into 3 coplanar photons of equal frequency and at 120° to one another.

W. J. SWIATECKI

539.167.3 : 541.13

Electrolytic dosage of radio-iron. *See Abstr.* 5751

NUCLEAR REACTIONS 539.17

539.172 : 537.542

A new method of measuring angular distributions. *See Abstr.* 5537

539.172 : 537.591.8

Nuclear reactions due to cosmic rays. *See Abstr.* 5560

539.172 : 541.126

5699. Possible explanation of the radioactivity induced by the detonation of shaped charges. L. GRUNBERG AND K. H. R. WRIGHT. Letter in *J. chem. Phys.*, **21**, 763 (*April*, 1953).

Results obtained by Fonberg [Abstr. 5735 (1951)] can be attributed to non-radioactive effects. The auto-radiographs could be the result of hydrogen peroxide formed on the metal surfaces; the Geiger–Müller counts could be temperature-induced spurious counts.

F. R. HOLT

539.172.13

5700. Nuclear interaction of protons of high energy. A. DADAYAN. *Dokl. Akad. Nauk SSSR*, **86**, *No.* 4, 683–6 (1952) *In Russian.*

The results of measurements of the cross-section of interaction of protons having energies from 0·4 to $2{\cdot}5\times10^9$ eV with the carbon nucleus are given. The measurements were carried out with a large magnetic counter spectrometer at a height of 3200 metres above sea level. The protons were generated in a lead block located over the spectrometer and were stopped in graphite plates located between the rows of counters. The distribution of momenta of the protons is given. The protons observed were divided into 3 groups: (1) those strongly deviated with no secondary emission, (2) those resulting in "stars" of secondary emission in the graphite, (3) those stopped with no secondary emission of charged particles. Total registration of trajectories and the percentages of each of the above groups are given. The cross-section of interaction of carbon with protons is $2{\cdot}3 \pm 0{\cdot}6\times10^{-25}$ cm^2 for energies up to 1×10^9 eV with no observable dependence on proton energy, though there may be a dependence of cross-section on the process taking place.

E. RABKIN

539.172.13

5701. Angular distribution of deuterons from $Be^9(p, d)Be^8$. B. L. COHEN, E. NEWMAN, T. H. HANDLEY AND A. TIMNICK. Letter in *Phys. Rev.*, **90**, 323 (*April* 15, 1953).

22 MeV protons were used with a thin target. The deuterons were detected by induced activities in Pb and Na. A pronounced forward peak was found. Results were extremely similar to some using 5 to 8 MeV protons (unpublished). F. R. HOLT

539.172.3

5702. Nuclear photo-effect at higher energies. YU. K. KHOKHLOV. *Zh. eksper. teor. Fiz.*, **23**, *No.* 3 (9) 241–5 (1952) *In Russian.*

The differential cross-section is calculated for the absorption of a photon passing through a proton-neutron mixture by electric interaction with a *p-p* or *p-n* pair, the nucleons being assumed to interact according to $U(r) = (g^2/r)e^{-\lambda r}$. Born approximation is used, and the effect of zero point motions is shown to be small. The resulting mean free path of the photon in nuclear matter is 10^{-10}–10^{-11} cm, the probability of absorption by a *p-n* pair being ~10 times that by *p-p*. (This is ascribed to the asymmetry of the former.) The angular distribution of 70 and 90 MeV photoprotons from C bombarded with 195 MeV γ's is estimated. The experimental peak at small angles between proton and γ [Abstr. 4722 (1951)] is roughly reproduced, but the absolute cross-sections come out ~100 times too small if $g^4 \sim \frac{1}{16}$ is assumed. W. J. SWIATECKI

539.172.3

5703. On the angular distributions of photomesons produced in nuclei. A. M. BALDIN AND V. V. MIKHAÏLOV. Letter in *Zh. eksper. teor. Fiz.*, **23**, *No.* 4 (10) 481–2 (1952) *In Russian.*

An error in the derivation of the energy spectrum of charged mesons given in Lax and Feshbach [Abstr. 3772 (1951)] is corrected. The angular distributions of scalar and ps.scalar mesons are found to be essentially different, but insensitive to the assumed momentum distribution of nucleons in the nucleus. W. J. SWIATECKI

539.172.3

5704. (γ, α) processes in Li^7_3, O^{16}_8, Br^{79}_{35} and Br^{81}_{35}. H. NABHOLZ, P. STOLL AND H. WÄFFLER. *Helv. phys. Acta*, **25**, *No.* 7, 701–24 (1952) *In German.*

The nuclear track plate technique was used. The ~6 MeV fluorine γ-rays were used for the photo-disintegration of Li, 17·6 MeV Li γ-rays for O and Br. For the reaction $Li^7(\gamma, \alpha)H^3$, a cross-section of $(2{\cdot}65 \pm 0{\cdot}8) \times 10^{-29}$ cm^2 results with fluorine γ-rays. The angular distribution of the photo-tritons is given by $W(\Theta) = 1 - (0{\cdot}1 \pm 0{\cdot}09) \cdot \cos\Theta$. The reaction $O^{16}(\gamma, \alpha)C^{12}$ has been found to give a cross-section of $(1{\cdot}95 \pm 0{\cdot}8) \cdot 10^{-28}$ cm^2 for quanta of 17·6 MeV. The (γ, α)-reaction on Br gave a cross-section of $(1{\cdot}2 \pm 0{\cdot}5) \times 10^{-28}$ cm^2 (mean value for both isotopes). This value is in good agreement with the theoretical results deduced from the statistical theory of nuclear reactions. A.

539.172.3

5705. Study of photo-disintegrations. I. Historical and bibliographical survey of the study of photo-disintegrations. R. CHASTEL. *J. Phys. Radium*, **14**, 50–5 (*Jan.*, 1953) *In French.*

The survey emphasizes the controlling influence of the availability of suitable sources of radiation. 86 references (up to July, 1951) are given. J. J. WILKINS

539.172.3

5706. Study of photodisintegrations. II. Some experimental results on photodisintegrations and their comparison with various theories. R. CHASTEL. *J. Phys. Radium*, **14**, 56–61 (*Jan.*, 1953) *In French.*

A review is presented under the sub-headings "medium and heavy nuclei" and "light nuclei," and is concerned mainly with (γ, n), (γ, p), (γ, d) and (γ, α) reactions. The absence of a nuclear model for light nuclei is stressed. 37 references are given. J. J. WILKINS

539.172.3

5707. The mechanism of the reaction $O^{16} + h\nu \rightarrow 4He^4$. C. A. HSIAO AND V. L. TELEGDI. Letter in *Phys. Rev.*, **90**, 494 (*May* 1, 1953).

An analysis of 230 "oxygen stars" produced by 48 MeV bremsstrahlung suggests that for $h\nu > 22{\cdot}4$ MeV the reaction goes through a ~16 MeV level in C (for $20{\cdot}4 < h\nu < 22{\cdot}4$, a 13 MeV level also contributes) and a 3 MeV level in Be. The sudden change in mechanism above $h\nu \sim 20$ MeV is discussed. W. J. SWIATECKI

539.172.4

5708. Non-observation of the reaction Fe(n, α)Cr under the action of thermal neutrons. H. FARAGGI. *J. Phys. Radium*, **14**, 160–8 (*March*, 1953) *In French.*

Irradiations of emulsions (some of which in contact with Fe foils of 0·455 or 0·800 mg cm^{-2}) with a flux of 4×10^{11} pile neutrons/cm^2 showed no increase associated with the Fe in the number of α tracks. An upper limit of 10^{-29} cm^2 for the cross-section is deduced. An analysis of more recent mass spectrographic measurements on Fe^{56} and Cr^{53} and reaction chains involving Cr^{53}, Mn^{53}, $Fe^{53,4,5,6}$ shows that the previously estimated value of 5 MeV for the α-energy is <3 MeV and probably ~0. Probable reasons for the opposite results of Hanni and Rossel (1950, 1952) and Longchamp (1952) are discussed. W. J. SWIATECKI

539.172.4

5709. On the presence of Co and Mn in Fe^{55} produced in the pile. A. MICHALOWICZ AND M. LEDERER. *J. Phys. Radium*, **13**, 669–70 (*Dec.*, 1952) *In French.*

Studies using Geiger counters, scintillation counters and paper chromatography all established the presence of Co impurity, but gave no evidence of Mn impurity. J. J. WILKINS

539.172.4 : 539.172.32

5710. Photo-neutrons in heavy water from uranium fission products. N. HOLT AND A. LUNDBY. *JENER Rep.*, *No.* 11, 4 *pp.* (1952).

The main source of the background flux of neutrons in the JEEP after shut down has been found to be due to photo-neutrons released in deuterium by a ~2·5 MeV γ-ray accompanying the decay of La^{140} which is in transient equilibrium with the 12·8 day Ba^{140} (fission yield 6%). A.

539.172.4

5711. Lecture notes on pile theory. C. A. RENNIE. *Atomic Energy Res. Establ.* [*Harwell*] *Lecture R/L5*, 34 *pp.* (1952).

Basic nuclear design features of natural uranium, graphite modulated, thermal reactors are dealt with under sections headed: diffusion theory, slowing down theory, lattice constants, critical size conditions, approach to critical conditions, control of a pile and pile kinetics. References are given to published papers giving a fuller treatment of points discussed. A.

539.172.4

5712. Apparatus for the measurement of reactivity in a nuclear reactor. J. WEILL. *J. Phys. Radium*, **14**, 77–81 (*Feb.*, 1953) *In French.* Translation in *Nucleonics*, **11**, 36–9 (*March*, 1953).

Three methods of measuring the period of divergence of a reactor are described. In the first method, the current from the ionization chamber is fed into a logarithmic amplifier (utilizing the logarithmic dependence of the potential across a thermionic diode upon the current passing through). The time derivative of the output gives the inverse of the pile period. The other two methods depend upon the fact that the pile period is equal to the ratio of the power level to the time derivative of the power level. In the one method this ratio is registered automatically by a recording potentiometer. In the other method, an a.c. potential, proportional to the power level, is applied to one pair of plates and a second a.c. potential, proportional to the time derivative, is applied to the second pair of the deflection plates of a cathode-ray tube. The resulting trace is a straight line whose inclination indicates the value of the reactor period.

L. R. SHEPHERD

539.172.4 : 531.717

5713. An arrangement for measuring the level of heavy water in the Saclay reactor. Generalization for measuring liquid levels and metal thicknesses. J. WEILL AND M. BRIÈRE. *J. Phys. Radium*, **14**, 46–9 (*Jan.*, 1953) *In French.*

An Invar wire is weighted by a lead bob and suspended from a drum. The drum is rotated by a small electric motor, which is actuated by an electronic device so that contact is maintained between a platinum point under the bob and the surface of the heavy water. A break in the contact causes the motor to turn the drum so as to wind the bob down and vice versa. This results in a small continuous oscillation of about 0·1 mm amplitude. The actual position of the point and liquid surface level is thus given by the angular position and number of rotations of the drum. This information is transmitted to a recorder by means of two rotary potentiometers linked to the drum. A positional accuracy of ±0·25 mm over a range of 2 m is obtained. It is thought that this method might be extended to measure metal thicknesses.

L. R. SHEPHERD

539.172.4 : 537.542

Calibration of boron ionization chambers indicating pile power-level, by a measurement of reactivity. *See Abstr.* 5536

ATOM AND MOLECULE BEAMS . MESONS . NEUTRONS 539.18

539.18

5714. On electrons produced in the decay of fast mesons. S. A. AZIMOV, V. F. VISHNEVSKIĬ AND K. P. RŸZHKOVA. *Dokl. Akad. Nauk SSSR*, **83**, *No.* 1, 55–8 (1952) *In Russian.*

The number of decay electrons is deduced by comparing the intensities of the soft component at 2 altitudes, with, in one case, an H_2O or C absorber equivalent to the intervening air. A study of the influence of the absorber thickness indicates that $\frac{1}{3}$ rather than $\frac{1}{2}$ of the meson's energy is transferred to the electrons, suggesting 3 particle decay.

W. J. SWIATECKI

539.18

5715. Evidence for the direct production of $\varkappa$-mesons. N. ISACHSEN, V. VANGEN AND S. O. SÖRENSEN. Letter in *Phil. Mag.*, **44**, 224–7 (*Feb.*, 1953).

Measurements on a 14 mm prong of a $16 + 3p$ star show that it is a stopped meson of mass $1000 \pm 200m_e$. Its 4 mm disintegration product has $p\beta = 126 \pm 21$ MeV/c and mass $\sim 200m_e$.

W. J. SWIATECKI

539.18

5716. Delayed disintegration of a heavy nuclear fragment. I. M. DANYSZ AND J. PNIEWSKI. Letter in *Phil. Mag.*, **44**, 348–50 (*March*, 1953).

A heavy fragment (charge ~ 5) from a 30 BeV $21 + 18p$ star stops in the emulsion after 90 μ to produce a low energy 4-track star. Analysis shows that the event is consistent with the disintegration (after $\geqslant 3 \times 10^{-12}$ sec) into $p^+ + \pi^-$ of a V_0' included in the heavy fragment. (Compare following abstract.)

W. J. SWIATECKI

539.18

5717. Delayed disintegration of a heavy nuclear fragment. II. D. A. TIDMAN, G. DAVIS, A. J. HERZ AND R. M. TENNENT. Letter in *Phil. Mag.*, **44**, 350–2 (*March*, 1953).

A heavy fragment (charge 2–3) from a 6 BeV $16 + 0p$ star produces a low energy 3-track star. Analysis shows that the event is consistent with the same interpretation as in the preceding abstract.

W. J. SWIATECKI

539.18

5718. A neutral V-particle from a low-energy nuclear interaction. J. P. ASTBURY, J. S. BUCHANAN, G. D. JAMES, D. D. MILLAR, J. A. NEWTH, D. I. PAGE, A. B. SAHIAR AND A. RYTZ. Letter in *Phil. Mag.*, **44**, 352–5 (*March*, 1953).

Discussion of a cloud chamber photograph of a ~ 6 BeV 9-track star coplanar with a 55° V track 3·5 cm away, consistent with either a V_1^0 or V_2^0 decay.

W. J. SWIATECKI

539.18

5719. Double meson photoproduction. R. D. LAWSON AND S. D. DRELL. Letter in *Phys. Rev.*, **90**, 326 (*April* 15, 1953).

Using ps.scalar theory with derivative coupling the cross-section $\sigma(E)$ for $\gamma + p \rightarrow p' + \pi^+ + \pi^-$ is calculated as function of the π energy E. For 400 MeV γ's $\int \sigma dE$ is $1 \cdot 15(g^2/4\pi)^2 m$ barn, where

($g^2/4\pi$) should be $\sim \frac{1}{18}$ from Lévy's analysis (1952) of the deuteron. W. J. SWIATECKI

539.18

5720. The disintegration of V^0 particles. R. W. THOMPSON, A. V. BUSKIRK, L. R. ETTER, C. J. KARZMARK AND R. H. REDIKER. Letter in *Phys. Rev.*, **90**, 329 (*April* 15, 1953).

In a plot of transverse momentum against the difference of the squares of the momenta of the positive and negative products, 2-body decay should give points on an ellipse, 3-body decay inside it. Of 17 recent cloud chamber events, 6 are consistent with $V^0 \rightarrow \pi + \pi + 210$ MeV, 8 with $V_1^0 \rightarrow p + \pi + 37$ MeV, but 2 are away from these ellipses.

W. J. SWIATECKI

539.18 : 539.172.3

5721. Photoproduction of π^0-mesons on deuterons. A. M. BALDIN AND V. V. MIKHAĬLOV. *Zh. eksper. teor. Fiz.*, **23**, *No.* 2 (8) 140–6 (1952). Shorter version in *Dokl. Akad. Nauk SSSR*, **84**, *No.* 1, 47–9 (1952) *In Russian.*

The cross-sections for (1) $\gamma + d \rightarrow d + \pi^0$, (2) $\gamma + d \rightarrow n + p + \pi^0$, are calculated by perturbation theory for ps.scalar mesons with ps.vector coupling. In the case of equal coupling constants, g_p and g_n, to proton and neutron, the cross-section of (1) for angles between γ and π less than 30° is 2 orders of magnitude smaller than for photoproduction of π^0 on a proton. For $g_p = -g_n$ the two cross-sections are approximately equal. These results are independent of the assumed wave-functions of the d. The cross-section for (2) is not sensitive to the relative signs of g_p and g_n. W. J. SWIATECKI

539.185

5722. Measurement of neutron densities by autoradiography of detectors. A. ERTAUD AND P. ZALESKI. *J. Phys. Radium*, **14**, 191–7 (*March*, 1953) *In French.*

A sensitive and precise method, particularly suited to the study of very non-uniform neutron flux densities, is described. Thin films, e.g. of silver, are placed in the flux and are then β-autoradiographed. Conditions for optimum accuracy ($\sim \pm 2\%$) and resolution are discussed. J. J. WILKINS

539.185

5723. Distribution of the density of thermal neutrons in a semi-infinite diffusing medium irradiated by a flux normal to its surface. J. BOURGEOIS, J. JACQUESSON AND P. ZALESKI. *J. Phys. Radium*, **14**, 198–202 (*March*, 1953) *In French.*

This has been measured by using autoradiographic detectors (preceding abstract) embedded in a paraffin block. Corrections for the effects of finite geometry and fast neutrons were determined experimentally. A theoretical calculation is also described, giving results in agreement (to $\pm$ 2%) with experiment.

J. J. WILKINS

539.185

5724. The neutron-electron interaction. D. J. HUGHES, J. A. HARVEY, M. D. GOLDBERG AND M. J. STAFNE. Letter in *Phys. Rev.*, **90**, 497 (*May* 1, 1953).

Measurements of the critical angle of reflection of 6·7 Å neutrons at a bismuth/liquid-oxygen interface show that the interaction can be represented by a potential of range e^2/mc^2 and depth 3860 $\pm$ 370 eV.

J. M. CASSELS

539.185 : 535.42

5725. A diffraction effect illustrating the transparency of nuclei to high energy neutrons. J. D. LAWSON. Letter in *Phil. Mag.*, **44**, 102–3 (*Jan.*, 1953).

The phase change δ caused by a slab, D cm thick, of refracting material in the path of a wave of high energy E is proportional to $D/E^{\frac{1}{2}}$. If this is used to estimate the E at which $\delta = \pi$ for C, Al, Cu, Cd, Pb, general agreement is found with the positions of the maxima in the neutron cross-sections found by Taylor and Wood [Abstr. 4361 (1953)]. W. J. SWIATECKI

STRUCTURE OF SOLIDS 539.2

539.217

5726. Determination of the coefficient of diffusion $D = D_0 + \alpha C$. B. YA. LYUBOV. *Dokl. Akad. Nauk SSSR*, **84**, *No.* 1, 97–100 (1952) *In Russian.*

An approximate form of the diffusion equation is derived, for constant diffusion coeff. D, when the diffusing substance is present initially as a layer of thickness h and diffuses through a prism of material of thickness x, and it is shown to be reasonably accurate for calculating D from experimental measurements, provided that $x < 10h$. The more complicated equation is derived for the case where D varies linearly with the concentration of the diffusing substance C. R. C. MURRAY

539.217.1

5727. Pore distribution in porous media. H. I. MEYER. *J. appl. Phys.*, **24**, 510–12 (*May*, 1953).

An attempt is made to determine the actual distribution of the pore sizes in a porous rock from the cumulative distribution of mercury injected into the rock with increasing pressure against capillary forces. The aim is to correct for those pores which could fill at a given pressure but which do not, because they are connected to the mercury source only by smaller pores. The presented correction is based on probability concepts. A.

539.26/.27

5728. The submicroscopic structure of elementary cellulose fibrils. A. FREY-WYSSLING. *Experientia*, **9**, *No.* 5, 181 (1953) *In German.*

There is a difference of the diameter of elementary fibrils in cellulose measured with the electron microscope or determined by X-ray analysis. This is explained by the assumption that the elementary fibrils have a well-crystallized interior covered by a paracrystalline peripheral layer. A.

539.26

5729. Study and interpretation of low-angle X-ray scattering by cellulose. G. FOURNET AND P. ANTZENBERGER. *C.R. Acad. Sci.* [*Paris*] **236**, 394–6 (*Jan.* 26, 1953) *In French.*

Curves are given for scattering by dry and wet natural ramie; the greater intensity from the wet specimen is explained on the assumption that disordered regions swell in the presence of water.

A. R. STOKES

539.26

5730. An X-ray diffraction study of the transformation of retained austenite by fracture. L. W. PATEMAN AND H. S. PEISER. Letter in *Nature* [*London*] **171,** 696–7 (*April* 18, 1953).

X-ray examination of a hardened 1½% Cr steel revealed retained austenite on a mechanically polished surface but not on a freshly produced fracture surface. It is suggested that at fracture surfaces the retained austenite is completely transformed by the highly localized shear deformation. A. E. DE BARR

539.26 : 539.219

5731. Measurements of clustering in solid Al–Zn alloys. P. S. RUDMAN, P. A. FLINN AND B. L. AVERBACH. Letter in *J. appl. Phys.*, **24,** 365 (*March*, 1953).

Measurements on the diffuse scattering of X-rays (monochromatized Co $K\alpha$ radiation) at 400°c from alloys containing up to 50 at. % Zn provide evidence that Zn atoms have more Zn neighbours than in a random solution; e.g. at 20 at. % Zn, each Zn atom has an average of 3·7 nearest neighbours.

A. D. LE CLAIRE

539.27

5732. A double-replica method using carbon layers. V. C. DALITZ AND J. A. SCHUCHMANN. *Optik*, **10,** *No.* 1–3, 143–6 (1953) *In German.*

The metal surface to be investigated is covered with a layer of evaporated Ag at least 5 μ in thickness. This layer is easily removed from the surface and is then covered with a thin layer of silica or, better, carbon. The Ag is dissolved in 40% nitric acid and the positive carbon replica transferred to the specimen carrier of the electron microscope. J. THEWLIS

539.27

5733. The recording electron diffractograph applied to the study of chemical and physical transformations. J. J. TRILLAT AND N. TAKAHASHI. *C.R. Acad. Sci.* [*Paris*] **236,** 790–2 (*Feb.* 23, 1953) *In French.*

By recording a sector of an electron diffraction pattern on a moving film, a phase transition in Cu–Al alloy has been followed as a continuous function of temperature. R. S. PEASE

539.27 : 539.217.1

5734. Data on the pore system of a membrane filter. J.-G. HELMCKE. *Optik*, **10,** *No.* 1–3, 147–9 (1953) *In German.*

Membrane filters are used in medicine for the detection of bacteria, and a knowledge of the pore apertures is of importance. These apertures are well below the resolving limit of the light microscope. Stereoscopic photographs taken with the electron microscope of filters treated with metallic vapour are given to show the surface texture; these include a photograph showing a stained *bact. coli* retained on the surface of a filter. H. J. H. STARKS

539.27 : 545.83

5735. Estimation of minerals by diffraction in the electron microscope. O. E. RADCZEWSKI. *Optik*, **10,** *No.* 1–3, 163–9 (1953) *In German.*

By using an electron microscope as an electron diffraction camera, the constituents of a mineral can be identified even when these are present in amounts which cannot be detected with the light microscope. In this way, the structure of materials such as clay can be investigated. A few examples are given.

H. J. H. STARKS

ELASTICITY . STRENGTH . RHEOLOGY
539.3/.8

539.373 : 548.736.1

5736. Neumann bands in pure iron. A. KELLY. *Proc. Phys. Soc.* [*London*] *A*, **66,** 403–5 (*April*, 1953).

An examination has been made, using an X-ray microbeam method, of Neumann bands in a crystal of pure iron. The lattice in the bands is shown to be twinned with respect to the matrix about a (112) pole.

A.

539.374 : 536.37

5737. Heat emanation during the process of plastic deformation. N. S. FASTOV. *Dokl. Akad. Nauk SSSR*, **83,** *No.* 6, 851–4 (1952) *In Russian.*

Formulae are derived for the amount of heat emanated during plastic deformation, and the energy of residual stresses, under the assumption that the material has a sharply defined yield point and its strengthening follows a linear law over a sufficiently wide range of deformation. A numerical example of a round cylinder subjected to twisting is given. Theoretical results are said to be in good agreement with experiment. INDEX AERONAUTICUS

539.42

5738. On the influence of cracks upon the mechanical properties of the given material under different stress conditions. YA. B. FRIDMAN, T. K. ZILOVA AND N. I. ZHUKOVA. *Dokl. Akad. Nauk SSSR*, **84,** *No.* 1, 67–70 (1952).

Experimental investigation of the so-called "early" cracks, i.e. the cracks in the zone in which takes place an appreciable concentration of plastic deformations, has been made. In the experiments test-pieces were used with already existing cracks, while the effect of the intensity of the development of the same upon the accumulative mechanical properties of the material was studied. Four different methods, which were used for creating and developing cracks, are described in some detail. Relevant drawings and one graph are supplied. It is, however, pointed out that the combined use of torsion with subsequent axial tension in the experiment does not reveal to the full extent the effect of surface cracks upon the mechanical properties of the material beyond the limit of uniform strain.

INDEX AERONAUTICUS

539.42

5739. Investigation of the starting points of fracture by optical methods. I. V. M. KRASNOV AND A. V. STEPANOV. *Zh. eksper. teor. Fiz.*, **23,** *No.* 2 (8) 199–210 (1952) *In Russian.*

Photoelastic methods were used to study the stressed state and starting points of fracture formed by the application of a point load in the direction [100] to the surface of a lithium fluoride crystal (1) annealed at 700°c, (2) unannealed, the edges of which corresponded to the directions [110].

A. GELBTUCH

539.42 : 539.89

5740. The effect of pressure on the tensile properties of several metals and other materials. P. W. BRIDGMAN. *J. appl. Phys.*, **24**, 560–70 (*May*, 1953).

Tension tests to fracture under superposed hydrostatic pressure reaching to nearly 30 000 kg/cm² have been conducted on five polycrystalline metals, Ni, Ta, Cb, Mo and W, two brittle single metallic crystals, Sb and Cu_5Zn_8, and two brittle amorphous materials, "Melmac 404" and B_2O_3 glass. All these materials exhibit ductility at the highest pressure; the largest increases are for the polycrystalline metals of which the largest is W, which breaks brittlely at atmospheric pressure but with 81% reduction of area at the highest pressure. The shape of the strain-hardening curves varies among the five metals from abrupt rise with long tailing off to long gradual rise with comparatively abrupt falling off, in the order W, Mo, Ta, Cb and Ni. The character of the fracture varies continuously with pressure and is different for the different metals. Of the brittle single crystals, Sb has a reduction of area of 55% at the highest pressure. The plastic, Melmac 404, gives the smallest increase of ductility, a reduction of area of only 14% at the maximum. This small value is doubtless associated with the absence of internal crystal slip planes. B_2O_3 glass gave a reduction of 87%; this is largely a phenomenon of plasticity, but there is an appreciable component of viscosity. Both amorphous materials showed an increase of density after pulling under pressure instead of a decrease. A.

539.893

5741. Super-high pressures and high temperatures obtained by the method of adiabatic compression. YU. N. RYABININ. *Zh. eksper. teor. Fiz.*, **23**, *No.* 4 (10) 461–7 (1952) *In Russian.*

An illustrated description of an apparatus for obtaining super-high pressures (up to 10 000 kg/cm²) in gases at high temperatures. The principle of operation is that of adiabatic compression. It is claimed that the apparatus can be used for the investigation of optical properties and electrical conductivity of gases at super-high pressures and high temperatures, and of their compressibility. The essential part of the apparatus is a "gun"-barrel, 365 mm long, 25·6 mm bore, provided with a specially designed piston. F. LACHMAN

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM . CHEMICAL REACTIONS 541.11/.12

541.124 : 535.343.4

5742. Some observations by spectrographic absorption of the decomposition of nitric oxide. J. GRANIER-MAYENCE, J. ROBIN AND S. ROBIN. *C.R. Acad. Sci.* [*Paris*] **236**, 1011–14 (*March* 9, 1953) *In French.*

Compressed NO decomposes easily, forming N_2O_3, N_2, N_2O and NO_2. The rate of decomposition depends upon pressure and temperature. NO shows a minimum of absorption between 4500 and 5500 Å, the position of which also depends on initial pressure, time and temperature. The position of this minimum might supply data for the NO decomposition and the nature of the products formed. Such experiments were carried out with NO under an initial pressure of 800 atm., which became stable after 20–30 hr at ~100 atm., some liquid having been formed. Several reactions are possible, those causing the largest decrease in volume being most favoured. Some qualitative conclusions are drawn concerning the possibilities of the various reactions with respect to the structures of NO. A. J. TAYLOR

541.124 : 541.14

5743. Kinetic study and mechanism of the photo-oxidation of liquid acetaldehyde. P. FILLET, M. NICLAUSE AND M. LETORT. *C.R. Acad. Sci.* [*Paris*] **236**, 1489–92 (*April* 13, 1953) *In French.*

The main product at −90° to −40°C is peracetic acid. Kinetic studies show that the yield is increased compared with that at ordinary temperatures, that the velocity is proportional to the square root of the luminous intensity, and that the velocity increases with increase in oxygen pressure to a maximum for which the corresponding energy of activation is 3·5 kcal. It is shown that these results may be interpreted by the same chain mechanism used to interpret the photo-oxidation in the gaseous phase. H. H. GREENWOOD

541.126

5744. On the spontaneous ignition and explosion limits of cyanogen-air mixtures. H. JAMES AND P. LAFFITTE. *C.R. Acad. Sci.* [*Paris*] **236**, 811–13 (*Feb.* 23, 1953) *In French.*

Spontaneous explosion limits for C_2N_2-air mixtures containing 7–74% C_2N_2 have been determined for sub-atmospheric pressures; the corresponding temp. range is 700–950°C. Except for very weak mixtures having a long induction period, mixtures containing <43% C_2N_2 gave very reproducible white flames having less than 3 sec ignition delay. Between 43% and 74% C_2N_2 violet flames were observed, which became fainter and less well defined as the conc. exceeded 60%. Over the region 7–58% C_2N_2 pressure-(p) and temperature-(θ°K) limits of explosion follow Semenoff's law $\log p = A\theta^{-1} + B$ where A and B are constants. A. SCHOFIELD

541.126

5745. On the kinetics of long-delay flames in mixtures of cyanogen and air. H. JAMES AND P. LAFFITTE. *C.R. Acad. Sci.* [*Paris*] **236**, 1038–41 (*March* 9, 1953) *In French.*

An extension, dealing with very weak mixtures, of an earlier more general paper (preceding abstract). Such mixtures, containing 4·5–13% C_2N_2, react with a bluish-white flame (above 600°C and between 100–600 mm Hg pressure) after a long ignition delay (in some cases >2 hr). The ignition delay τ for a given reaction vessel is given by $\tau = Kp^{-n} \exp(-E/RT) f(C)$

where K and n are constants, p the sum of the partial pressures of C_2N_2 and O_2, E the activation energy and $f(C)$ a function of gas composition. It was found that, betw. 4·5–7% C_2N_2, $n = 0·705$ $(\pm\frac{1}{2}\%)E = 66$ kcal/gm mol $(\pm 1\%)$. The function $f(C) = [p(C_2N_2)][p(O_2)]^2/[p(N_2)]$. The form of the dependence of τ upon the other parameters in the above equation suggests that a chain reaction mechanism is operative in these long-delay flames. A. SCHOFIELD

541.127.1 : 534.39 : 541.15

5746. The effect of insonation on the specific reaction rate constant in the acid hydrolysis of ethyl acetate. D. THOMPSON, F. C. VILBRANDT AND W. C. GRAY. *J. Acoust. Soc. Amer.*, **25**, 485–90 (*May*, 1953).

Three frequencies, 400, 700 and 1500 kc/s, were employed. A specially designed reactor, commercially fabricated from Pyrex, was employed to maintain approximately isothermal conditions for the tests. Insonation was for periods of 10 and 20 minutes at temperatures of $19 \pm 0·1$ and $30 \pm 0·1$°c. The course of the reaction was followed in such a way that the concentrations of the reacting substances were not disturbed. Specific reaction rates were increased in the order of 5% for 20-minute insonation over the rates for 10-minute insonation. A.

ELECTROCHEMISTRY 541.13

541.13 : 534.39 : 537.365

5747. Ultrasonic waves and electrochemistry. I. A survey of the electrochemical applications of ultrasonic waves. E. YEAGER AND F. HOVORKA. *J. Acoust. Soc. Amer.*, **25**, 443–55 (*May*, 1953).

The applications of ultrasonic waves in electrochemistry are discussed in terms of (1) the effects of ultrasonic waves on electrode processes, (2) electrokinetic phenomena involving ultrasonic waves, and (3) the use of ultrasonic waves as a tool in the study of the structure of electrolytic solutions. A.

541.13 : 534.39 : 537.365

5748. Ultrasonic waves and electrochemistry. II. Colloidal and ionic vibration potentials. E. YEAGER, H. DIETRICK AND F. HOVORKA. *J. Acoust. Soc. Amer.*, **25**, 456–60 (*May*, 1953).

When ultrasonic waves are introduced into an ionic solution or a suspension of charged colloidal particles, alternating potential differences are generated between points separated by a finite distance in the direction of propagation (other than an integral multiple of the wavelength). Pulse-modulated ultrasonic waves have been used to study these effects at a carrier frequency of 200 kc/s. The colloidal vibration potentials have been measured in a number of colloidal silica suspensions of various concentrations, particle sizes and conductivities. The experimental results are in general agreement with the mathematical treatment of Enderby. Measurements of ionic vibration potentials in KCl solutions indicate a value of 6 μV/cm.sec^{-1} for a 10^{-3} M solution. This value corresponds to a difference of 80 in the apparent gram-ionic-masses of the hydrated K and Cl ions. A.

541.13 : 534.39 : 537.365

5749. Ultrasonic waves and electrochemistry. III. An electrokinetic effect produced by ultrasonic waves. H. DIETRICK, E. YEAGER, J. BUGOSH AND F. HOVORKA. *J. Acoust. Soc. Amer.*, **25**, 461–5 (*May*, 1953).

If a wire covered with a fibre or a porous coating is submerged in a dilute electrolytic solution and irradiated with ultrasonic waves, an alternating potential of the same frequency is produced on the wire relative to the bulk of the surrounding solution. The effect has been studied with pulse-modulated ultrasonic waves at a carrier frequency of 200 kc/s. For a double-cotton-covered copper wire in 0·0001 M NaCl solution, the open circuit response has been found to be approximately 10^{-7} V/dyne.cm^2. In general, the acoustical response is dependent on the nature and concentration of the electrolyte, the pH, and the type of covering, but independent of the metal. The effect is explained on the basis of the interaction of the ultrasonic waves with the diffuse double layer of ions surrounding the fibres of the covering. Hydrophones involving this effect offer particular advantage at frequencies above 100 kc/s because of the small dimensions of the acoustically sensitive elements. A.

541.13 : 534.39 : 537.365

5750. Ultrasonic waves and electrochemistry. IV. The production of alternating components in the potential of a polarized hydrogen electrode with ultrasonic waves. H. DIETRICK, E. YEAGER, J. BUGOSH AND F. HOVORKA. *J. Acoust. Soc. Amer.*, **25**, 466–9 (*May*, 1953).

If sound waves interact with an electrode upon which a gas is being liberated by electrolysis, an alternating potential of the same frequency is developed on the electrode relative to the bulk of the surrounding solution. The effect has been studied in the case of a polarized hydrogen electrode with pulse-modulated ultrasonic waves at a frequency of 200 kc/s. Under favourable conditions the amplitude of the alternating potentials is of the order of 10^{-8} V/dyne.cm^{-2}. The effect has been found to depend on the formation of gas bubbles at the electrode surface. Although the amplitude of the effect is a function of the conductance of the solution and the current density, it is essentially independent of the hydrogen ion concentration of the solution in the range 10^{-4} to 10^{-8} M and is also independent of the specific metal upon which the hydrogen gas is being liberated. On the basis of these results, the effect is attributed primarily to the modulation of the *i-r* drop in the solution immediately adjacent to the electrode surface by periodically expanding and contracting gas bubbles. A.

541.13 : 539.167.3

5751. Electrolytic dosage of radio-iron. J. GOVAERTS AND A. LAMBRECHTS. *Bull. Soc. Roy. Sci. Liège*, **21**, 531–6 (*Dec.*, 1952) *In French.*

Describes a simple apparatus for the electrolytic dosage of radio-iron ($_{26}Fe^{59}$ and $_{26}Fe^{55}$), working with 12 electrolysis vessels simultaneously. Radio-iron is first purified by repeated precipitation, and a neutral solution of chloride, to which NH_4 oxalate and oxalic acid has been added, is electrolysed for 2 hours, using Cu pastilles as cathodes. Radioactive activities

determined for several pastilles show that the relative error of a single preparation is $< 4\%$, the average relative error being 2·2, and 0·4%, for the two series of measurements tabulated. F. LACHMAN

541.133

5752. Voltage dependence of the electrical conductivity of strong non-associating electrolytes with consideration of the space requirements of the ions. H. FALKENHAGEN AND G. KELBG. *Ann. Phys.* [*Leipzig*] **11**, *No.* 4–7, 389–96 (1953) *In German.*

In continuation of a previous theoretical investigation [*Z. Phys.*, **32**, 353 (1931)], the importance is shown of the time of relaxation of the ionic atmosphere in electrolytes theory, and its connection with the Wien voltage effect. Previous theory is extended and former calculations are revised with special consideration of ionic dimensions, which entail the use of a new distribution function. The time of relaxation is found to possess a definite magnitude in the stationary case, which shows that the dissymmetry of the ionic atmosphere for great ionic velocities can develop no further. H. H. HODGSON

541.133

5753. High field conductance of some symmetrical valence-type strong electrolytes. A. PATTERSON, JR. *Proc. Nat. Acad. Sci. U.S.A.*, **39**, 146–52 (*March*, 1953).

Quantitative relations are drawn between the high field conductance behaviour of symmetrical 2–2 and 3–3 valence type electrolytes. Data with curves are given for $CuSO_4$, $ZnSO_4$, $MgSO_4$ and $LaFeC_6N_6$. The disparity between the experimental and theoretical curves computed from the Onsager–Wilson modification of the Onsager conductance equation is similar to that between the low field conductance of 2–2 and 3–3 electrolytes; on the other hand, 1–1 strong electrolytes conform to theory in conductance, transference numbers, and other properties. A solution to the problem is found in the assumption of incomplete dissociation into ions, and the assignment of an equilibrium constant to express the degree of weakness of the higher valence-type strong electrolytes; one of the most probable causes for this weakness is the formation of ion-pairs by the higher valence-type ions under the influence of Coulombic forces. 9 refs. H. H. HODGSON

541.135.4

5754. Contribution to the study of the diffusion of ions through metallic coatings. II. Effect of concentration. H. MAKRAM. *C.R. Acad. Sci.* [*Paris*] **236**, 920–1 (*March* 2, 1953) *In French.*

See Abstr. 1215 (1953). The variation of the period of passage T of labelled Cu ions through Cu plates coated with Cr at constant thickness e, in a solution of $CuSO_4$ of various concentrations C (2N, N, N/2, N/3, N/5), is a function of C, viz., $\ln T = ke/c + k'$, where k and k' are constants. The expression which holds for small values of e is: $\ln T = \ln (\exp.^{ke/c} - 1) + k'$. 3 data curves.

H. H. HODGSON

541.135.5

5755. The electrochemistry of gallium. W. M. SALTMAN AND N. H. NACHTRIEB. *J. Electrochem. Soc.*, **100**, 126–30 (*March*, 1953).

Electromotive force measurements were made on cells of the type Ga (s or l)/GaX_3 + HX/H_2(Pt) where X is chloride or perchlorate at 20°, 25°, 28° and 35°C, for various gallic ion concentrations at several constant acidities. The standard electrode potential for the gallium-gallic ion electrode in aqueous solution at 25°C is found to be $-0{\cdot}560 \pm 0{\cdot}005$ V. The standard free energy at 25°C was calculated to be $-38\,800$ cal mole^{-1}. The standard entropy and enthalpy for the cell reaction at 25°C were estimated to be $-39{\cdot}2$ cal mole^{-1} and $-50\,500$ cal mole^{-1}, respectively. The liquid gallium electrode behaved in an irreversible manner, but electroplated solid electrodes behaved satisfactorily. A.

541.135.5

5756. The capacity of polarized platinum electrodes in hydrochloric acid. W. D. ROBERTSON. *J. Electrochem. Soc.*, **100**, 194–201 (*April*, 1953).

Electrode capacity of platinum electrodes was measured in hydrochloric acid by an impedance bridge. Capacity was determined as a function of polarizing voltage, concentration, and frequency. It appears that electrode capacity cannot be interpreted exactly in terms of a simple equivalent circuit. Capacity, calculated as a series circuit, goes through a minimum at 20 μf/cm^2 and $+0{\cdot}75$ V on the N calomel scale. Comparison of platinum with mercury at the minima indicates that the difference in potential, 1·85 V, corresponds to the contact potential difference. A.

541.135.5

5757. Influence of polyvinyl alcohol (Rhodoviol BS 100) on the overvoltage of Cu in a solution of $CuSO_4$. M. BALKANSKI. *C.R. Acad. Sci.* [*Paris*] **236**, 921–3 (*March* 2, 1953) *In French.*

The overvoltage of Cu in a solution of $CuSO_4$ is measured in the presence of macromolecules, viz., of the polyvinyl alcohol, Rhodoviol BS100, at different temperatures and in the presence of oxygen or nitrogen. The overvoltage-concentration curves exhibit displacements proportional to the concentration of the alcohol within a certain range.

H. H. HODGSON

PHOTOCHEMISTRY . RADIATION CHEMISTRY 541.14/.15

541.15

5758. Chemical dosimetry at high dose-rates. N. MILLER. *Nature* [*London*] **171**, 688–90 (*April* 18, 1953).

Using a mechanically switched cell for short exposures on 2 MeV X-rays, $FeSO_4$ reduction is shown to be independent of dose rate up to 10^5r per min. The absolute yield of ferric ions is found to be $20{\cdot}3 \pm 1{\cdot}0$ ions per 100 eV expended in the solution. Similar studies are given for cerous ion production.

F. T. FARMER

541.15

5759. Reduction of ceric salts and oxidation of ferrous sulphate by polonium α-particles. M. HAISSINSKY AND M. DO CARMO ANTA. *C.R. Acad. Sci.* [*Paris*] **236**, 1161–3 (*March* 16, 1953) *In French.*

At concentrations between 10^{-4} and 3×10^{-3}M in sulphuric acid solution (0·8N), reduction of ceric ion is proportional to the radiation dose (ferrous sulphate

dosimetry) almost to completion. It is independent of the Ce concentration, but varies with the nature of the anion and with concentration of dissolved Po. The rate of reduction is increased by the addition of $HClO_4$ or HNO_3 to the H_2SO_4 solutions, the G value being almost doubled. The yield is diminished by addition of H_3BO_3. The oxidation of $FeSO_4$ (10^{-3}M in 0·8N H_2SO_4) is independent of the α-ray intensity, the G value being about 6 over a wide range of Po concentrations. C. B. ALLSOPP

541.15

5760. Reduction of ferric ion in aqueous solution by γ-radiation. C. B. AMPHLETT. *Nature* [*London*] **171**, 690–1 (*April* 18, 1953).

Ferric sulphate solutions in sulphuric acid have been irradiated with Co γ-rays in the presence of air at acidities up to pH 2·5. Initially, reduction of ferric ion occurs. At pH 2·46, the yield is 15 ions reduced per 100 eV, which is comparable with 17 Fe^{2+} ions oxidized per 100 eV under the same conditions. At higher doses a steady state is reached, the rates of Fe^{3+} to Fe^{2+} varying with initial Fe^{3+} concentration. A similar steady state is reached when a solution containing both ferric and ferrous ion is irradiated. Possible chemical mechanisms are discussed. C. B. ALLSOPP

541.15 : 534.23

5761. Inhibiting action of oxygen acceptors on the effect of ultrasonics. J. LOISELEUR AND M. PETIT. *C.R. Acad. Sci.* [*Paris*] **236**, 918–20 (*March* 2, 1953) *In French.*

Oxidation produced by ultrasonic vibration is inhibited in the presence of hydrogen. The present work shows that while ultrasonic waves cause a marked diminution in the potency of strychnine, the presence of oxygen acceptors will greatly inhibit this effect, the type of acceptor being very important, however. T. C. TOYE

CHEMICAL STRUCTURE 541.2/.6

541.57

5762. Geometrical classification of bonds and of chemical groups. Influence of the environment on the properties of bonds. R. DAUDEL. *Bull. Soc. Chim. France*, **20**, 533–7 (*May*, 1953) *In French.*

In a series of hydrocarbons, the carbon-carbon distances fall into distinct groups. The chemical links are interpreted as the ensemble of pairs of nearest neighbours. Similarly the angles between links thus defined fall into distinct groups according to the nature of the central atom, which depends, for example, upon the number of nearest neighbours. It is therefore possible to characterize an atom by the number of nearest neighbours and their disposition in space, and from this to classify the lengths of bonds between pairs of atoms so characterized.

H. H. GREENWOOD

541.62 : 535.343.3–15

5763. Infrared spectra of some disubstituted derivatives of cyclohexane. Structure considerations. M. LARNAUDIE. *C.R. Acad. Sci.* [*Paris*] **236**, 909–11 (*March* 2, 1953) *In French.*

See also Abstr. 8532 (1952). There are two optically different 1,2 cyclohexane diols. As each OH group can be substituted in two ways (κ or ε), there are four combinations possible. Accordingly the two enantiomorphic structures 1(ε), 2(κ), and 1(κ), 2(ε) must be tautomers. Similarly ε,ε can change into κ,κ, but as these (*trans*) structures are not equivalent, optical activity is caused. The *trans* spectrum shows an intense double band at 1080 cm^{-1}, caused by C–OH valence vibrations. This must originate with the κ,κ structure, as in the ε,ε structure these two vibrations are not in phase. For the spectra of 1,2 dichloro- and dibromo-cyclohexanes a similar explanation holds, although of these compounds, no *cis* and *trans* forms have been obtained with certainty. The bands observed in the *trans* 1–4 dichloro- and dibromo-cyclohexane spectra suggest the presence of $\varepsilon\varepsilon$ and $\kappa\kappa$ structures, their proportion depending on concentration in the solutions. The structure 1(κ), 4(ε) is insufficient for the explanation of the complex absorption spectrum of the *cis* 1–4 dichlorocompound: perhaps the "boat" structure of the cyclohexane ring is responsible for some of the bands. Although less bands were observed in the corresponding bromine compound spectrum, a similar assumption is necessary for the explanation. A. J. TAYLOR

541.64 : 536.421.1

5764. The rotational-isomerism theory of the melting of crystalline polymers. M. V. VOL'KENSHTEĬN AND O. B. PTITSYN. *Dokl. Akad. Nauk SSSR*, **86**, *No.* 4, 677–80 (1952) *In Russian.*

By statistical thermodynamics the internal energy of a linear polymer composed of chains each of N links is calculated. In the most crystalline state all the links are assumed to be in the *trans* configuration relative to their neighbours and the energy necessary to change one link to the *cis* position is known from measurements on simple compounds. Values are calculated for the melting ranges of polyethylene and polyisobutylene which agree well with the experimental values. A. L. MACKAY

541.65 : 535.343

5765. Chemical modulation: a method for investigating transient molecules. E. J. BAIR, J. T. LUND AND P. C. CROSS. Letter in *J. chem. Phys.*, **21**, 759 (*April*, 1953).

If discharge pulses are sent through NH_3, NH_2 radicals are formed, as can be shown by their absorption near 5977 Å. The maximum absorption varies with the time after the pulse. If the concentration of a chemical species can be varied periodically, such absorption can be used to modulate a transmitted light intensity. In order to test the method an experiment was performed. The apparatus used is described. A. J. TAYLOR

CHEMICAL PROCESSES 542.9

542.927 : 534.23

5766. Dissolution of steel in sulphuric acid under the influence of ultrasound. A. P. KAPUSTIN AND M. A. FOMINA. *Dokl. Akad. Nauk SSSR*, **83**, *No.* 6, 847–9 (1952) *In Russian.*

Above a certain threshold intensity, ultrasound

accelerates the dissolution of steel in dilute H_2SO_4, possibly by removing H_2 bubbles which screen the surface from the acid. The rate of dissolution is constant. Some preliminary results are also reported showing that ultrasound much accelerates the dissolution of sugar, $CuSO_4$ and $Na_2S_2O_3$ in H_2O, and of thymol in its own melt, 40° above the m.pt.

R. C. MURRAY

CRYSTALLOGRAPHY 548

548.1

5767. The so-called law of crystallographic symmetry. N. V. BELOV. *Dokl. Akad. Nauk SSSR*, **88**, *No.* 1, 63–5 (1953) *In Russian.*

Elementary textbooks on crystallography (including the author's) have shortcomings in their presentations of the proof of the non-existence of 5-fold, 7-fold and higher crystallographic axes. Improvements are suggested. A. L. MACKAY

548.5

5768. The envelopment of obstacles by the front of a growing layer of a crystal face. G. G. LEMMLEIN. *Dokl. Akad. Nauk SSSR*, **84**, *No.* 6, 1167–9 (1952) *In Russian.*

It is found that the front of a layer growing tangentially over a crystal face proceeds somewhat like a wave-front following Huyghens' principle. Each point reached by the growth front can be regarded as a possible pseudo-centre of growth. When the front encounters obstacles it spreads out after passing between them as do waves in the analogous case. Such behaviour has been observed in the case of growth on the 0001 face of SiC crystals where the growing layer had to pass round small pieces of graphite and other impurities. A. L. MACKAY

548.5

5769. Growth patterns on synthetic cadmium sulphide. A. R. WEILL. Letter in *J. Phys. Radium*, **13**, 587 (*Nov.*, 1952) *In French.*

Similarities between the observed morphology of CdS crystals and that reported for Be and Ti crystals prepared electrolytically are mentioned. The elementary spiral was not observed. S. WEINTROUB

548.5

5770. Epitaxis in polycrystalline films. O. S. HEAVENS AND L. E. COLLINS. *J. Phys. Radium*, **13**, 658–60 (*Dec.*, 1952) *In French.*

See also Abstr. 8263 (1950). Results of the examination by electron diffraction of thin films of Cu, Ag, Au and Al deposited on a thin layer of Cr on glass are given and discussed. The Cr adheres strongly to the glass only when the speed of condensation is less than 5–10 Å/sec, and the adhesion of Ag, Al and Au to the Cr increases considerably when the thickness of the Cr reaches 300–400 Å. For Cu the adhesion is independent of the thickness. The structure suggests epitaxial growth, the adhesion increasing when the interatomic distances of the upper metal lattice are not very different from those of the Cr. S. WEINTROUB

548.5

5771. The theory of twins in the growth of metals, alloys and layer crystals. G. S. ZHDANOV. *Dokl. Akad. Nauk SSSR*, **83**, *No.* 5, 685–8 (1952) *In Russian.*

The succession of close-packed layers in hexagonal or cubic orientations in crystals such as SiC and Mn is discussed. The occurrence of superlattices, very long repeat distances and solid solutions are explained in terms of packing errors. A. L. MACKAY

548.5

5772. Crystal faces as a function of the supersaturation of the mother liquors. R. KERN. *C.R. Acad. Sci.* [*Paris*] **236**, 830–3 (*Feb.* 23, 1953) *In French.*

For salts of NaCl and CsCl type in aqueous solution and in alcohol, a table and graph is given of the degrees of supersaturation needed for formation of different crystal faces. For increasing concentration of NaCl, (100) appears first, then dendritic formations along [111], then (111) and again dendrites along [100]. For CsCl: (110) first, dendrites along [100], and then (100). The explanation is analogous to that given in Abstr. 6164 (1952). C. TURNER

548.5

5773. Influence of the degree of supersaturation of mother liquors and of impurities on crystal faces. R. KERN AND M. TILLMANN. *C.R. Acad. Sci.* [*Paris*] **236**, 942–4 (*March* 2, 1953) *In French.*

For a small supersaturation any amount of impurity has no influence. For a given salt and a given impurity there is a definite degree of supersaturation for which the crystal faces change, but this point lies lower than for a pure solvent. Graphs are given for several salts and impurities. The methods employed are as in the preceding abstract. C. TURNER

548.574

5774. Observations of dislocations in lineage boundaries in germanium. F. L. VOGEL, W. G. PFANN, H. E. COREY AND E. E. THOMAS. Letter in *Phys. Rev.*, **90**, 489 (*May* 1, 1953).

The boundaries in nearly perfect single crystals, revealed by etching, were found under high magnification to consist of regularly spaced overlapping conical pits. That each pit is the site of an edge dislocation was strongly indicated by the good agreement found between the observed pit spacing and the spacing of dislocations calculated, on Burgers' dislocation model of a boundary, from the X-ray measured difference in orientation of the grains flanking the boundary, and the Burgers vector.

A. D. LE CLAIRE

MOLECULAR AND X-RAY CRYSTALLOGRAPHY 548.7

548.7

5775. The electrostatic energy of ionic networks. F. BERTAUT. *J. Phys. Radium*, **13**, 499–505 (*Nov.*); *Erratum*, 633 (*Dec.*, 1952) *In French.*

The density distribution of a system of point charges q_j may be written as $\rho(x) = \Sigma q_j \delta(x - r_j)$

and by use of the properties of the δ function the Patterson function may be derived in terms of the Fourier transforms $F(h)$ of $\rho(x)$. The total energy W_t consists of two parts, the interaction energy W_i and the infinite self energy W_s. Alternatively the charges are regarded as extended in space and a new density distribution is defined by $\rho'(x) = \Sigma q_j \sigma(x - r_j)$, where the σ are normalized non-overlapping spherically symmetrical functions. The σ-functions may then replace the δ-function in the previous analysis leading to a modified Patterson function derived in terms of the Fourier transforms $F(h)$ and $\phi(h)$ of ρ and σ. The interaction energy may now be determined in terms of F and ϕ as the difference between W_t and W_s where W_s now remains finite. The method is applied to the NaCl system in which σ is defined by assuming the ions to be uniformly charged spheres of radius equal to half the Na–Cl separation. The expansion of W_i in terms of ϕ and the structure factors F converges rapidly and gives a value in good agreement with that generally accepted. A method is also given for calculating the error when overlapping of the σ is assumed. H. H. GREENWOOD

548.7

5776. On the energy spectrum of an electron in a polar crystal. S. V. TYABLIKOV. *Zh. eksper. teor. Fiz.*, **23**, *No.* 4 (10) 381–91 (1952) *In Russian.*

The energy spectrum of a single electron in an ionic crystal has been theoretically investigated, with the interactions between the electron and the polarization produced by itself being taken into account. It is found that the spectrum has a zonal character, and that the width of the zones is significantly dependent on the value of the coupling of the electron with the polarization of the lattice. The positions of the centres of the zones are dependent to a smaller degree on the coupling. E. RABKIN

548.7 : 535.43

5777. Basis of a molecular theory of the Rayleigh scattering in crystals. L. TAUREL. *C.R. Acad. Sci.* [*Paris*] **236**, 682–4 (*Feb.* 16, 1953) *In French.*

Expresses the induced moment, for a cubic crystal with one atom per unit cell, as a function of the effective electric field and the polarizability of the atom. The moment is found to be the sum of three terms, dependent on variation of density, polarizability and the induced internal field. C. TURNER

548.7

5778. Temperature changes of $BaTiO_3$ single crystals. I. N. BELYAEV, N. S. NOVOSIL'TSEV, E. G. FESENKO AND A. L. KHODAKOV. *Dokl. Akad. Nauk SSSR*, **83**, *No.* 5, 675–6 (1952) *In Russian.*

From high temperature X-ray photographs the cell size variation of $BaTiO_3$ with temperature was found to be similar to that for polycrystalline material [Abstr. 1394 (1946)] except that the transition occurred at 60° for a sample prepared from a solution of $BaTiO_3$ and at 100° for a sample prepared by double decomposition. A. L. MACKAY

548.7 : 535.345.2

5779. Overtones in ionic crystals. I. M. DYKMAN AND S. I. PEKAR. *Dokl. Akad. Nauk SSSR*, **83**, *No.* 6, 825–8 (1952) *In Russian.*

Calculations are made by the "effective mass" method developed by Pekar (1951), for overtone electrons making allowance for ionic oscillations and assuming the orbital radii of the electron or the positive "hole" to which it is attached to be so large that they can be regarded as a system of opposite point charges. It is shown for both the $1s$ and $2p$ states of the H_2-like spectrum given by the overtone, the electron causes no inertial polarization ("non-polarizing overtone") if the effective mass ratio k of the hole to overtone (or vice-versa) is < 8, but inertial polarization is caused if k is > 8, and n^2c is large (n = refractive index, $c = (1/n^2) - 1/\varepsilon$); the overtone is then said to be "polarizing." Both types occur when k is > 8, but n^2c is small. R. C. MURRAY

548.73/.74 : 539.26/.27

X-ray and electron investigation of materials. *See Abstr.* 5728–35

548.734.2

5780. The effect of a Soller slit on the diffraction of X-rays by deformed crystals. B. D. CULLITY AND C. A. JULIEN. *J. appl. Phys.*, **24**, 541–6 (*May*, 1953).

In the application of the Guinier–Tennevin focusing Laue method to the study of crystal distortion, it is found that the use of a Soller slit in the incident beam produces striations in reflections from certain crystals. The diffraction geometry of a beam so modified is examined in detail, and it is shown that the striations are due to torsion of the crystal. The relation between the amount of torsion and the slope and spacing of the striations is treated quantitatively. There results a useful extension of the focusing Laue method by which not only the bending, but also the torsion, of a crystal may be measured. A.

548.735

5781. Calculation of electron-density distribution in crystals with the help of convolution operations. R. HOSEMANN AND S. N. BAGCHI. *Nature* [*London*] **171**, 785–7 (*May* 2, 1953).

Smooth curves are drawn through sets of measured structure amplitudes, and these are expressed as sums of a few Gaussian curves, whose Fourier transforms can be found immediately. A convolution (or "folding") operation then gives the electron-density distribution. Errors due to cut-off effect are eliminated in this way. The application to NaCl is taken as an example. A. R. STOKES

548.735.4

5782. A direct method of determining the signs of the structure amplitudes. Z. V. ZVONKOVA AND G. S. ZHDANOV. *Dokl. Akad. Nauk SSSR*, **86**, *No.* 3, 529–32 (1952) *In Russian.*

For a centrosymmetric structure, if $H_j = 2\pi(h_1x_j + h_2y_j + h_3z_j)$, then for the jth atom $\cos(H_j + K_j) + \cos(H_j - K_j) = 2\cos H_j \cos K_j$. Multiplying by f_j and summing for all j, $F(H + K) + F(H - K) = 2\sum_j f_j \cos H_j \cos K_j$. $\overline{C_H(K)}$ is defined as $\sum_j \cos H_j \cos K_j / \sum_j \cos H_j$ and, substituting, $F(H+K) + F(H - K) = 2F(H) \cdot \overline{C_H(K)}$. This equation is used for relating the signs of the structure amplitudes. It is further shown that for a given K the sign of $\overline{C_H(K)}$ is generally the same for changes in H. It is also possible to use the arithmetic mean $\overline{\cos(K)} = \sum_j \cos K_j / n$. This gives an equation for the signs of the structure

factors, if $F(H)$, $F(K)$ and $F(HK)$ are large, $S_H = S(S_K \cdot S_{H+K})$. A. L. MACKAY

548.735.6

5783. A method for the quantitative determination of preferred orientation. L. K. JETTER AND B. S. BORIE, JR. *J. appl. Phys.*, **24**, 532–5 (*May*, 1953).

A new method for the study of preferred orientation in polycrystalline materials with a Geiger counter X-ray spectrometer is described. The unique feature of the method is that a spherical diffraction specimen is employed. Sufficient data for the construction of a complete pole figure may be obtained, and the observed intensities may be plotted directly on a stereographic net without geometry or absorption corrections. The method may be used satisfactorily with the heavy metals, since X-rays are not transmitted through the specimen. A technique for accurately machining and electroetching spherical specimens is given, and the special goniometer used with the spectrometer is described. Sample data are given and their interpretation discussed. The method is compared with other recently developed techniques for the study of preferred orientation. A.

548.736.3

5784. The crystal structure of the higher oxides of metals in the first group of the periodic system. G. S. ZHDANOV AND Z. V. ZVONKOVA. *Dokl. Akad. Nauk SSSR*, **82**, *No.* 5, 743–6 (1952) *In Russian.*

Discussion of recent work, particularly that of Templeton and Dauben [*J. Amer. Chem. Soc.*, **72**, 2251 (1950)], on β–NaO_2 in the light of the authors' measurements. The spherically-symmetrical O_2 ion has an 0–0 distance of $1{\cdot}31 \pm 0{\cdot}03$ Å in an NaCl-type structure with $a = 5{\cdot}44$ Å. 18 references.

A. L. MACKAY

548.736.3 : 539.132

The structure of B_4Cl_4. *See Abstr.* 5642

548.737

5785. The crystal and molecular structure of octamethylnaphthalene: a non-planar naphthalene derivative. D. M. DONALDSON AND J. M. ROBERTSON. *J. Chem. Soc.*, **1953**, 17–27 (*Jan.*).

Crystals of octamethylnaphthalene have been examined by quantitative X-ray analysis. They are orthorhombic, space-group D_{2h}^{22}–*Ccca*, with four molecules of $C_{18}H_{24}$ per unit cell. The molecular symmetry is 222, the asymmetric crystal unit consisting of one-quarter of the chemical molecule. In electron-density projections obtained from two-dimensional Fourier syntheses not all the atoms can be resolved, but the molecule is definitely non-planar. The α-methyl groups are displaced from the mean plane by about $0{\cdot}73$ Å, and the β-methyl groups are displaced in an opposite direction by some smaller amount, probably between $0{\cdot}25$ and $0{\cdot}40$ Å. Symmetry requires an alternate up-and-down displacement of all the methyl groups around the molecule. It is also probable that the naphthalene nucleus itself is distorted, to a smaller extent but in a similar way, but this cannot be definitely established from the data. A.

548.74

5786. Electron diffraction in the chemistry of the solid state. A. L. G. REES. *J. Roy. Soc. New S. Wales*, **86**, *Pt II*, 38–54 (1952).

Liversidge Lecture. New theoretical techniques for the solution of structural problems using electron diffraction patterns obtained from single crystals are reviewed. Correction of the observed pattern for secondary scattering is discussed. G. I. W. LLEWELYN

GEOPHYSICS 55

550.312

5787. On a way of calculating isostatic anomalies. H. DE CIZANCOURT. *C.R. Acad. Sci.* [*Paris*] **236**, 835–7 (*Feb.* 23, 1953) *In French.*

Presents a method of calculating isostatic anomalies based on the equilibrium of vertical tensions produced by topographic loads, according to the relaxation hypothesis, and the pressures due to the deformation of the underlying material. The compensating masses are defined without arbitrary constants and the physical nature of isostatic equilibrium or disequilibrium can be studied. A. H. COOK

550.341

5788. Notes on the *T*-waves. P. MOLLARD. *Ann. Géophys.*, **8**, *No.* 3, 335–6 (1952) *In French.*

Critical survey of arguments in favour and against the proposed interpretation of recent observational work by Ewing, Press and Wortel [*Bull. Seismol. Soc. Amer.*, **42**, 37–51 (*Jan.*, 1952)]. A. BEER

550.341

5789. Refraction of seismic waves travelling on the sea bed. Application to the *T*-waves. J. COULOMB. *Bull. Acad. Roy. Belgique Cl. Sci.*, **38**, *No.* 5, 547–53 (1952) *In French.*

The behaviour of deep under-water seismic *T*-waves is studied, in particular for the case where these originate from *S*-waves whose velocity is close to that of sound in the sea. A. BEER

550.37

5790. On the evaluation of geoelectric depth soundings by an integral equation method. W. BUCHHEIM. *Wiss. Z. Tech. Hochsch. Dresden*, **2**, *No.* 3, 337–41 (1952–53) *In German.*

Outlines a method of utilizing integral equations for the determination of the resistance-depth function from the experimental results obtained by the Schlumberger form of geoelectric layout. No applications of the method are given. J. M. HOUGH

550.371

5791. A new aspect of the natural electric field in the earth. A. V. VESHEV, A. S. SEMENOV AND M. E. NOVOZHILOVA. *Dokl. Akad. Nauk SSSR*, **87**, *No.* 6, 939–41 (1952). *In Russian.*

It is shown that anomalies in the field along a given profile are correlated in their magnitude with changes

of temperature of the earth. It is suggested that the anomalies are caused by local variations in the composition of the rock. J. M. HOUGH

550.381

5792. Causes of the magnetic properties of certain soils. S. Hénin and E. Le Borgne. *C.R. Acad. Sci.* [*Paris*] **236,** 736–8 (*Feb.* 16, 1953) *In French.*

Certain soils possess a much higher magnetic susceptibility than the rocks from which they are derived. Granulometric analysis indicates that this property resides mainly in the smallest grain component, i.e. in the clay. The agent responsible does not seem to be magnetite; it is suggested that it is γFe_2O_3. A. T. PRICE

550.384.3

5793. The mean geomagnetic field and its secular variation in Adélie Land at 1st January, 1952. P. N. Mayaud. *C.R. Acad. Sci.* [*Paris*] **236,** 954–6 (*March* 2, 1953) *In French.*

Measurements of D, H, I were made at Port Martin (141° 24′ E., 66° 49′ S.) from May, 1951, to January, 1952, and monthly mean values of X, Y, Z derived. By removing the seasonal variation on the assumption that it is similar in character, but displaced in phase, to those at Godhavn and Juliannehaab, an estimate of the secular variation was obtained. This was used to reduce the field to the epoch January 1, 1952, the values found being $X = 845\gamma$, $Y = 646\gamma$, $Z = -69\,175\gamma$, $H = 1063\gamma$, $D = 37°\,24'$ E., $I = 89°\,06'$ S. A. T. PRICE

550.42

5794. Vertical distribution of radium in deep-sea sediments. V. S. Kröll. Letter in *Nature* [*London*] **171,** 742 (*April* 25, 1953).

Samples obtained from the Pacific by the Swedish Deep-Sea Expedition showed irregular variation of radium content with depth. Results suggest that most of the Ra is ionium-supported; the migration of Ra is proved. (See following abstract.) A considerably higher content of dissolved U in late quaternary times is probable. A sedimentation rate of 1 mm in 1000 years is deduced. F. R. HOLT

550.42 : 539.16.08

5795. Ionium determination in deep-sea sediments. N. Isaac and E. Picciotto. Letter in *Nature* [*London*] **171,** 742–3 (*April* 25, 1953).

Th234 was added as a tracer, and after chemical purification, the ionium concentration was found by observing the α-tracks in a nuclear emulsion. The Th234 β's gave the yield. The samples were from the Pacific (see preceding abstract). The results support the ionium precipitation hypothesis, and suggest a lack of radio-active equilibrium between ionium and Ra. The method developed permits the detection of a concentration of 1 in 10^{-11} in a few mg. F. R. HOLT

550.839 : 539.169

5796. Radioactive measurements in geology. I. Nuclear physical fundamentals. H. v. Buttlar and I. Wendt. *Arch. tech. Messen, Issue* 201 (*Ref. V* 655–1) 225–8 (*Oct.*, 1952) *In German.*

Gives a review of the theoretical basis and the radiations and elements of interest. The bibliography applies to Pts II and III also (see abstract following). F. R. HOLT

550.839 : 539.16

5797. Radioactive measurements in geology. II Measuring instruments. III. Practical applications H. v. Buttlar and I. Wendt. *Arch. tech. Messen Issué* 202 (*Ref. V* 655–2) 251–4 (*Nov.*, 1952) *In German*

Apparatus (e.g. Geiger counter, scintillation counter) is briefly described, and numerous examples of applications are given. F. R. HOLT

550.93

5798. Isotopic composition of lead and the age of the earth. A. P. Vinogradov, I. K. Zadorozhnyĭ and S. I. Zȳkov. *Dokl. Akad. Nauk SSSR,* **85,** *No.* 5 1107–10 (1952) *In Russian.*

The isotopic compositions of Pb in 32 samples of galena collected about the globe were measured mass-spectrographically. The ages of the samples ranged from 25×10^6 to 1600×10^6 yr. The minimum and maximum ages of the earth's crust are found to be $2{\cdot}1 \times 10^9$ and $5{\cdot}0 \pm 0{\cdot}5 \times 10^9$ yr, respectively.

NUCLEAR SCIENCE ABSTRACTS

551.491 : 536.42 : 536.8

5799. On the utilization of subterranean water above the critical pressure. G. Claude. *C.R. Acad. Sci.* [*Paris*] **236,** 670–2 (*Feb.* 16, 1953) *In French.*

Discusses the possible employment of such natural waters for the development of power. F. E. HOARE

ATMOSPHERE . METEOROLOGY 551.5

551.501.8 : 538.566.2 : 621.396.11 : 621.396.91

Report of factual data from the Canterbury project. A radio-meteorological investigation in the South Island of New Zealand. *See Abstr.* 5592

551.510.535

5800. Travelling disturbances in the ionosphere: diurnal variation of direction. G. H. Munro. Letter in *Nature* [*London*] **171,** 693–4 (*April* 18, 1953).

Travelling disturbances in the *F*-region [see Abstr. 4306 (1949), 7632 (1950)] are shown to exhibit a definite diurnal variation in the direction of horizontal movement between 0900 and 1500 hrs, most marked in June. Limited night observations also suggest significant changes between day and night.

G. M. BROWN

551.510.535 : 538.566.3

Radio-wave propagation in the ionosphere. *See Abstr.* 5594–6

551.513

5801. Equations of motion of the atmosphere integrated along the vertical. J. van Mieghem. *Publ. Inst. Roy. Météorol. Belgique, No. B* 3, 3–23 (1952) *In French.*

To investigate possible energy conversions in the atmosphere on the scale of the general circulation, averages are taken for a domain of space, or for a space domain large with respect to the volume and the local lifetime of the perturbations embedded in the mean flow. Mean values along the vertical only are considered. The energy equations for non-averaged motion deduced from the equations of atmospheric dynamics and the first law of thermodynamics are quoted, and the corresponding equations for the vertically averaged motion and for large-scale

eddy motion (thermal wind) are obtained. These energy equations form an equation of balance and the energy fluxes and rates of energy production and conversion are deduced. These energy equations are applied to large atmospheric disturbances. It is shown that the main energy conversions occur between the potential and kinetic energy of the thermal wind and between the kinetic energy of the thermal wind and that of the vertically averaged motion. The same energy equations may be applied to the atmospheric "models" and from the equation of the vertically averaged motion a basic equation of these "models" is deduced such that all simplifying assumptions appear clearly. Finally the energy transformations in a thermally and mechanically isolated system are envisaged. R. S. READ

551.521

5802. On the conduction of energy by long wave radiation in the air layer near the ground. O. CZEPA. *Z. Meteorol.*, **5**, 292–300 (*Oct.*, 1951) *In German.*

Tables, based on data by Schnaidt and Robinson, are given for transparency of the atmosphere with different amounts of water vapour and CO_2, total black body radiation -70 to $+50°C$, and radiation cooling of lower atmosphere by a cold surface in % of temperature difference. An example from Tulln, Lower Austria, of energy transport by long wave radiation from superheated ground to an overlying air mass with an adiabatic gradient, is worked out.

METEOROLOGICAL ABSTRACTS

551.521.3 : 551.575

5803. On the transmissibility of light through a cloud [of] particles. (For the wave-lengths from 4320 Å to 9500 Å.) A. KOBAYASHI. *J. Meteorol. Soc. Japan*, **29**, 139–46 (*May*, 1951).

Fogs were produced artificially in a cloud chamber and transmission of light of various wavelengths measured. Low-pressure steam gave maximum transmission (0·4) at 4700 Å and minimum (0·3) at 5050. Fog from a water sprayer (mean diameter 0·02 mm) showed maximum (0·4) at 4700 and a broad minimum (0·3) from 5500–6500 Å. Tobacco smoke showed maximum transmission (0·4) at 4800 Å and minimum (0·28) at 5200 followed by a steady increase to 0·6 at 9500. Neither Rayleigh's nor King's scattering formula applied.

METEOROLOGICAL ABSTRACTS

551.524

5804. Remarks on the calculation of atmospheric temperature. R. GRANDMONTAGNE. Note in *Ann. Géophys.*, **8**, *No.* 4, 443–6 (1952) *In French.*

Reference is made to the calculation of atmospheric temperature from measurements of pressure obtained with rockets. A procedure is outlined by means of which the temperature at each km of height can be obtained more accurately and the levels where the temperature gradient changes. The method is illustrated by temperature-height curves for rocket ascents on Jan. 28 and May 3, 1949. R. S. READ

551.577 : 539.155.2

5805. The potential usefulness of natural tritium. W. F. LIBBY. *Proc. Nat. Acad. Sci. U.S.A.*, **39**, 245–7 (*April*, 1953).

It is suggested that the tritium activity of rainwater may be used to measure the time since the water was deposited on the earth. Applications suggested are the measurement of the time since agricultural products were harvested, the origin of sources of water and in meteorological studies of air masses. A fairly large sample of water is needed to measure the tritium activity. An investigation is in progress of the amount of tritium in the waters of the earth and it is suggested that this will lead to an upper limit for the average residence time of a He^3 atom in the earth's atmosphere. J. M. HOUGH

551.577.21 : 551.501.8 : 621.396.969

5806. Utility of radar in measuring areal rainfall. G. E. STOUT AND J. J. NEILL. *Bull. Amer. Meteorol. Soc.*, **34**, 21–7 (*Jan.*, 1953).

Areal rainfall distribution over a 50-square-mile area was observed by 3 cm radar and by a rain-gauge network of 33 rain gauges. Isohyetal maps were prepared from both rain-gauge and radar observations in order to compare the rainfall distribution as observed by the two rainfall observation techniques. The computed rainfall values were at least as accurate as those obtained by a rain-gauge network of one gauge per 200 square miles and in some cases they were considerably more accurate. A.

551.577.5

5807. Possible influence of the moon on atmospheric precipitation. H. MINEUR. *Ann. Géophys.*, **8**, *No.* 3, 294–308 (1952) *In French.*

For Clermont–Ferrand, Parc St Maur, Nantes and Algiers the mean ($\bar{h}$) rainfall has been extracted for each lunar day (J) for a period of 70 years, i.e. about 800 lunar periods. Five-day means ($\bar{\bar{h}}$) of rainfall were also obtained. For Parc St Maur and still more at Nantes $\bar{h}$ and $\bar{\bar{h}}$ are a maximum at 3rd moon day and a minimum at 18th. For Nantes the ratio max./min. is 1·17. No connection between $\bar{h}$ or $\bar{\bar{h}}$ and J appears at Clermont–Ferrand and for Algiers the relation is inconsistent. There is a maritime climate at Parc St Maur and Nantes and a continental climate at Clermont-Ferrand. Algiers adjoins a tideless sea but no effect of tide is found. The probability of a rainless day leads to the same results. The procedure adopted was tested by the Labrouste method and found to be legitimate and extremely selective for the lunar period and its sub-multiples. R. S. READ

551.578.4

5808. On the fall velocity of snowflakes. C. MAGONO. *J. Meteorol.*, **8**, 199–200 (*June*, 1951).

A report of an experiment on the fall velocities of snowflakes of various sizes and of snow crystals. The velocity is approximately proportional to the square root of the maximum diameter of a snowflake.

METEOROLOGICAL ABSTRACTS

551.578.7

5809. Scattering of microwaves by a melting spherical ice particle. M. KERKER, P. LANGLEBEN AND K. L. S. GUNN. *J. Meteorol.*, **8**, 424 (*Dec.*, 1951).

Back scattering of 10 cm radar from a melting ice sphere of radius 0·2 cm is calculated by the theory of Aden and Kerker. Results show a rapid increase during early stages of melting.

METEOROLOGICAL ABSTRACTS

551.593.5

5810. Some properties of the atmospheric indicatrix for scattered light. E. V. PYASKOVSKAYA-FESENKOVA. *Dokl. Akad. Nauk SSSR*, **88**, 53–6 (1953) *In Russian.*

It is shown that at an angle of between 55° and 60° the light scattered is the same as that which would be scattered if the scattering was independent of angle.

J. M. HOUGH

551.593.6

5811. Note on reflection and diffraction from ice crystals in the sky. P. JACQUINOT AND C. SQUIRE. Letter in *J. Opt. Soc. Amer.*, **43**, 318 (*April*, 1953).

An explanation is given of a phenomenon reported earlier [Abstr. 568 (1953)]. Flat surfaces of crystals are supposed to be in a horizontal plane and the openings between the crystals considered nearly circular. With the sun shining obliquely the effective openings are elliptical in the plane of the incident light. This will give rise to the diffraction pattern seen with the major axis of the ellipse pointing towards the sun. The contour lines of equal intensity are elliptical and the central image as well as the annular ring are elliptical.

R. S. READ

551.594.71 : 621.396.11

5812. Continental maps of four ionosphere disturbances. R. S. LAWRENCE. *Trans Inst. Radio Engrs Prof. Group on Antennas and Propagation, No.* 3, 214–16 (*Aug.*, 1952).

*fF*2 data from 13 N. American stations were combined to study the characteristics of four storms of moderate intensity. Two of the storms, although world-wide in extent, appeared to exhibit localized centres (dimensions 2000–4000 km) which moved with the progress of the storm.

W. J. G. BEYNON (R)

BIOLOGY 57/59

578.088

5813. The effects of biological tissues on 15 Mc/s pulsed ultrasound. J. J. WILD AND J. M. REID. *J. Acoust. Soc. Amer.*, **25**, 270–80 (*March*, 1953).

A quartz transducer transmits longitudinal waves through water to the tissue to be examined and also receives the reflected wave, which is displayed on an oscilloscope. The thickness of the tissue or the velocity of sound in the tissue and the pattern of the echoes from within the tissue may be obtained. Results are given showing how the apparatus has been used for detecting malignant and non-malignant tumours, which give different echo patterns. The implications of the work in cancer study are discussed.

G. F. HODSMAN

578.088.75 : 538.569.2.047

5814. Certain physiologic and pathologic effects of microwaves. J. F. HERRICK AND F. H. KRUSEN. *Elect. Engng*, **72**, 239–44 (*March*, 1953).

Experiments using 12·2 cm waves on animals confirm that primary effects are due to heating, and temperature changes are measured and correlated with blood flow. Whole body irradiation on rats causes a decrease in eosinophil and lymphocyte counts; the chief danger is of cataract formation which occurs with 75 watts protracted over several hours.

F. T. FARMER

MEDICAL SCIENCE . HUMAN PHYSIOLOGY 61

612.843.16

5815. Stray light and the human electroretinogram. R. M. BOYNTON. *J. Opt. Soc. Amer.*, **43**, 442–9 (*June*, 1953).

A scotopic (*b*-wave) component of the human electroretinogram which results from small (1° to 12°) area stimulation has previously been shown to arise almost entirely from stray light in the eye which weakly illuminates large peripheral areas where the rods predominate. It is now indicated that for intermediate (45°) areas, a double-peaked *b*-wave is elicited which is believed to reflect activity aroused separately by image and stray light stimulus components. When extremely large (over 100°) stimulus areas are used, a unimodal response can be elicited using very weak luminances of stimulation. Since the large area response is mainly attributable to direct retinal stimulation, a basis is provided for comparing the effects of stray light (small area) and direct (very large area) stimulation. From such comparisons, it is concluded that (1) over four times as much luminous flux is required for a small stimulus to elicit a given *b*-wave as for a very large one to do so, (2) one of the stray light components is Rayleigh (small-particle) scatter, and (3) large-particle scatter and reflection from the fundus are also involved.

A.

612.843.16

5816. Electrical responses of the light-adapted eye. J. C. ARMINGTON. *J. Opt. Soc. Amer.*, **43**, 450–6 (*June*, 1953).

Recordings of the human electroretinogram (an electrical response to light originating in the retina) are made while the eye is maintained at any one of three different levels of light adaptation. Conventional recording techniques and procedures are used. A single waveform displaying relative spectral sensitivity in agreement with the ICI photopic luminosity function is found throughout the middle and long wavelength portions of the spectrum, but short wavelengths are more effective in arousing electrical responses than would be predicted by the ICI curve. Although there is a considerable effect upon the magnitude of the electrical response, relative spectral sensitivity is not greatly affected by changes in degree of light adaptation. Two night-blind observers, however, were found to give a diminished response to blue stimulation.

A.

612.843.31

5817. The perception of color in 1° fields for different states of adaptation. R. W. G. HUNT. *J. Opt. Soc. Amer.*, **43**, 479–84 (*June*, 1953).

The variations in the hues and saturations of colours, when seen under different intensities of

adapting light, have been measured by the binocular matching technique, using a 1° field. The results were very similar to those obtained using a 20° field. The theoretical implications are discussed. A.

612.843.31

5818. Spectral sensitivity of the fovea. I. Neutral adaptation. L. M. HURVICH AND D. JAMESON. *J. Opt. Soc. Amer.*, **43**, 485–94 (*June*, 1953).

The spectral sensitivity of the 1° fovea of the right eye of two practiced observers was measured at 10 mμ intervals from 400 mμ to 700 mμ for the dark-adapted state and for the bright-adapted (10mL), chromatically neutral state. Ten complete luminosity functions were obtained for each observer for each of the specified adaptations. The data of these experiments are intended to provide controls against which to evaluate luminosity data for different chromatic states. A number of inflections and shoulders are found in the functions for both states of adaptation. Moreover, the functions for both observers are shown to undergo a change in form and a displacement from the bright to the dark-adapted state. These changes in the foveal functions, although small in magnitude, are in the same sense as the familiar "Purkinje shift." Alternative theoretical explanations of the data are discussed and analysed. A.

612.843.37

5819. Studies of the form of visual threshold data. H. R. BLACKWELL. *J. Opt. Soc. Amer.*, **43**, 456–63 (*June*, 1953).

There are three principal alternative assumptions about the form of threshold data collected by presenting each of a number of light intensities repeatedly and determining the probability of discrimination for each. These assumptions are that the data will conform to (*a*) Poisson sums; (*b*) normal ogives; or (*c*) log normal ogives. Decision among these assumed curves is of interest for theoretical reasons, and also to permit selection of a procedure for the analysis of visual threshold data. The present study indicates the similarity among the assumed curves, and reports an analysis of the number of experimental data required to differentiate among them, which number is so large that it appears unlikely that published threshold data are adequate for this purpose. Experimental data are reported which are sufficiently numerous to permit a partial decision among the assumed curves. A total of 27 482 measurements was made by 4 subjects, under constant physical conditions. Data from three of the subjects can be fitted by normal ogives, but not by log normal ogives. Data for the fourth subject can be fitted by log normal ogives, but not by normal ogives. All the data can probably be fitted by one or another Poisson sum, provided there are no theoretical limits on their parameters. That the curves actually represent Poisson sums is regarded as unlikely, however, since a prediction concerning the magnitude of the thresholds is not verified. The analyses suggest that threshold data can probably be adequately analysed in terms of either normal or log normal ogives and that visual theories should depend upon other predictions than the form of the threshold data. A.

612.843.611

5820. Effectiveness of red light on dark adaptation. W. R. MILES. *J. Opt. Soc. Amer.*, **43**, 435–41 (*June*, 1953).

Some studies of 1941–42 indicated that adaptation under red light was faster than in darkness. A recent research report seems to show a facilitative effect of red light on dark adaptation and has renewed interest in this problem. Some of the earlier data purporting to show this effect, additional material previously unpublished, and also new studies made by the method of simultaneous differential monocular adaptation are here presented and discussed. Adaptation goggles were used for 25 min under illumination of 8 mL. The filter over one eye was a glass disk made of Corning No. 2403, deep red, 3·5% photopic transmission, over the other eye an opaque cardboard disk which excluded all light. Dark adaptation thresholds (Hecht–Schlaer adaptometer) violet light (Corning 5513), measured alternately on the two eyes showed for 16 college student subjects lower values, i.e. increased light sensitiveness for the eyes adapted in darkness. In the period 6 min after removing the goggles the mean threshold difference between results for red and opaque procedures in the first test was $-0{\cdot}153 \log I\mu\mu L$, $<P = 0{\cdot}01$; in the second test with the goggles reversed on the two eyes the mean difference favouring the opaque side was $-0{\cdot}182 \log I\mu\mu L$, $<P = 0{\cdot}01$. The earlier and later results are not easily harmonized. The author argues in favour of the monocular method as an appropriate one for the study of this problem. A.

612.843.612

5821. Calculation of visibility. N. I. PINEGIN, N. G. BOLDYREV AND O. D. BARTENEVA. *Dokl. Akad. Nauk SSSR*, **84**, *No.* 3, 483–6 (1952).

Calculation of visibility should be based on the relation between the changes of the sharpness of discernment and the contrast of the objects concerned against their background. Smirnov's formula for the case of light adaptation of the human eye is given. Although in Smirnov's experiments the objects were lighter than the background it is being proved that his formula holds good for the opposite conditions, which is the case with the determination of meteorological visibility. Based on this consistency, a formula is offered for observing objects against the sky on the horizon. Results of experiments with various objects are given in two tables, whereby it is stressed that theory agrees well with experimental results. INDEX AERONAUTICUS

612.843.72

5822. Factors affecting differences in apparent size between opposite halves of a visual meridian. K. T. BROWN. *J. Opt. Soc. Amer.*, **43**, 464–72 (*June*, 1953).

A difference in apparent size between opposite halves of the same visual meridian may be called a half-meridional difference (HMD). The HMD's have been measured in six subjects. Significant differences were found between the HMD's of the left and right eyes in both meridians. Thus an ocular factor contributes to HMD's. This factor appears to be different visual angles for corresponding retinal points. Trends were sometimes found with

respect to time, so there is also an unstable factor in the visual system which contributes to HMD's. This factor varies independently along the horizontal and vertical meridians. With a given meridian, however, the HMD's of the left and right eyes vary concomitantly. Thus the unstable factor is common to the two eyes and is probably located in the visual cortex. Since trends were found, apparent size in a given part of the visual field sometimes varies gradually but markedly with respect to time. This means that for a given locus of retinal stimulation the subjective directional value relative to a foveal stimulus varies in a similar manner with respect to time. Thus topological transformations of subjective directional values have been found to occur. HMD's produced by the ocular factor appear relatively stable and usually small, whereas the HMD's of the left and right eyes are modulated concomitantly by the unstable factor, which sometimes causes large HMD's. These findings indicate that the relation between visual angles for a pair of corresponding retinal points is relatively stable, but the subjective directional values of both members of the pair with respect to a foveal stimulus sometimes vary markedly and concomitantly as a function of time. A.

612.843.72

5823. Aniseikonia and the Howard–Dolman test. L. L. SLOAN AND A. ALTMAN. *J. Opt. Soc. Amer.*, **43**, 473–8 (*June*, 1953).

The effects of artificial aniseikonic errors on the moving-rod type of depth-perception test were studied in two subjects. Aniseikonia in the horizontal meridian produced a constant error in the setting of the movable rod whose direction and magnitude varied with the direction and magnitude of the aniseikonia. In the Howard–Dolman test the constant errors were only one-third to one-half those predicted from the binocular disparity. In a modified test in which opposing monocular cues were eliminated, the settings showed the expected constant errors of about 65 mm for each one % difference in the size of the ocular images. The mean variation about the average position of subjective equidistance showed considerable day-to-day variation. A.

612.85

5824. Contribution to a scientific basis of single channel sound transmission. II. P. BURKOWITZ. *Funk u. Ton*, **7**, 10–26 (*Jan.*, 1953) *In German.*

For Pt I, see Abstr. 2116 (1953). In single channel sound transmission the effects of sound intensity and relative transmission times between the reflected and direct sound has been considered and defined. From this is deduced a theoretical basis for a subjective transmission system. A. B. WOOD

612.83

5825. Attempted explanation of "supraliminaire" audition and a mathematical analysis. J. L. VECKMANS AND G. VAN WEYENBERGH. *Ann. Télécomm.*, **8**, 123–6 (*April*, 1953) *In French.*

The authors remark on the disagreement between the possible auditive reality of a subject and the appearance of the audiometric curve. The cause of this disagreement is shown to be found in the complexity of the functioning of the ear which may be compared with a receiver of variable damping. Most experience shows an increase of sensation more rapid than that predicted by Fechner's law. The author indicates a probable physiological mechanism to explain this phenomenon, to which he ascribes the name "enacousie" and he explains certain apparent paradoxes of audiometry by the pathological variations of the enacousie. "Hyperacousie" and "apoacousie" correspond respectively to the growth of sensation more rapid or less rapid than the normally observed growth. A. B. WOOD

615.849.7 : 539.16.08

5826. Use of tracers in chemical dosimetry. G. RUDSTAM AND T. SVEDBERG. Letter in *Nature* [*London*] **171**, 648 (*April* 11, 1953).

Irradiated $FeSO_4$ solution yields trivalent Fe in proportion to the radiation dosage received. Here a small admixture of active Fe^{59} is used as a tracer for measurement of the percentage of ferric ions after irradiation of the solution with a Co^{60} source, and chemical separation. Measurements of small dosages (0–100 r) can be easily made to an accuracy of ±2%. Different dosage ranges are obtainable by changing the concentration of solution. The suitability of KCl solution for chemical dosimetry is also considered, though stability at high sensitivity is not possible.

D. V. MABBS

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778.34 : 537.534.75

On a new method of determining the masses of charged particles by means of photoemulsions. *See Abstr.* 5531